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INFORMATION SERVICES AND THE MACHINERY OF GOVERNMENT

THE debate in the House of Lords on January 23 on the Earl of Perth's motion on the need for reform of the machinery of government was concerned more particularly with the control of foreign affairs, and apart from Lord Templewood's suggestion in regard to bringing the British Council into much closer contact with the universities in Great Britain and possibly seconding its staff from the universities, contributed little that was new to a discussion that, as the Earl of Perth remarked, had been proceeding very widely during the last four years. The plea that foreign affairs should be taken out of politics as much as possible was reiterated, but the general consensus of opinion as to the need for reform will assuredly be disappointed by the Lord Chancellor's reference to the Machinery of Government Committee, and in particular his statement that the Government does not intend to publish the reports of that Committee. If the Government proposes to continue merely availing itself of the Committee's recommendations and bringing them into force week by week and month by month, while refusing to debate openly the question of the machinery of government, the inference is likely to be drawn that the fundamental issues are being burked and that the Government is only tinkering with the problem.

That inference might in fact be legitimately drawn from the Lord Chancellor's reference to the report of the Haldane Committee, and public opinion may not be inclined to follow the Lord Chancellor in his claim that there has been no withdrawal by the Government from the pledge of its predecessor to give the fullest information to Parliament. The position is all the more regrettable in that the very programme of nationalization to which the Government is committed raises the question of the adequacy of the present machine to discharge the many new functions which it will now have to fulfil. Sir Arthur Salter has said that "The distinctive task of our age is not to extend scientific achievement but to improve the regulative mechanism of government in its widest sense"—and a large part of that improvement must be public understanding of what the Government proposes, and why.

That, of course, is why the question of the Ministry of Information is of such importance in home affairs, no less than in foreign affairs; and even in the statement made by Mr. Attlee so recently as March 8, there seems no clear realization that the nature of the information services of the future is a real test of sound thinking on the machinery of government under modern conditions. The Prime Minister has admitted that such services have a permanent place in the machinery of government and that it is essential to good administration under a democratic system that the public should be adequately informed on the many matters in which government action impinges directly on their daily lives. He agrees that it is also important that a true and adequate picture of British policy, institutions and way of life

should be presented overseas; but he showed little sign of having grappled with the real departmental issue, or of having considered the fundamental issues which the problem raises.

The words of Sir Arthur Salter quoted above form the starting point of a stimulating contribution to such thinking in Prof. K. C. Wheare's inaugural lecture on "The Machinery of Government", given before the University of Oxford on November 16, 1945[1]. Suggesting that the form of government which exists in Great Britain to-day can be described with substantial accuracy as a parliamentary bureaucracy and that such a system, in which both elements are organically integrated and controlled by a cabinet system, is the ideally best form of democratic government for a modern industrial State, Prof. Wheare points out that it is also, of all forms of government, the most difficult to work well and the most liable to decline. The machinery of government in a parliamentary bureaucracy must be constantly under review, and never more so than at a time like this when we emerge from a great war to undertake the formidable tasks of government in a period of reconstruction.

Prof. Wheare regrets that so far we have had no document comparable to the report of Lord Haldane's Machinery of Government Committee, which still illuminates the path of the student to-day. He regrets still more that we have had no detailed study of the rapid growth of bureaucracy in all forms of social institutions in Great Britain during the last seventy years. That development he regards as of much greater interest and importance than the growth of State bureaucracy. The latter has been a growth consequential upon the wider and fundamental development of bureaucracy in society as a whole: there are far more bureaucrats outside the Government service than inside.

These studies for which Prof. Wheare looks may well be part of the contribution to politics which the university might make if it undertook the teaching and study of politics, as Prof. D. W. Brogan[2] suggested in an inaugural lecture at Cambridge on November 28, 1945. The development of new and deeper understanding of old truths, and the teaching by example, that it matters a great deal with what cannon and what ammunition you assail the forts of folly are clearly the methods which Prof. Wheare has in mind in considering how to deal with bureaucracy. Bureaucracy, be it remembered, for all its dangers, is an essential part of our whole social organisation, and the real task is to devise the appropriate methods for the control of bureaucracy.

Prof. Wheare points out that the Cabinet is intended to be the principal instrument of that control, and the members of the Cabinet are chosen for that purpose because they have the confidence of the House of Commons. At the same time, the efficiency of a Minister depends on the efficiency of the bureaucracy which serves him. The ideal bureaucrat in our system is the man who can make the best case for and against a policy, who is prepared to indicate his own preference, but who encourages the Minister always to take the initiative and the responsibility for decisions. Energy in the executive is still a leading character in the definition of good government.

Whether individual Ministers succeed or fail in controlling their several departments, there is still the problem of Cabinet control and co-ordination of all the departments, and the observations of the Select Committee on National Expenditure in various reports on this point issued during the War contributed largely to the present debate on the machinery of government. Prof. Wheare has no hesitation in proposing some reduction in the size of the Cabinet from the pre-war figure of between twenty and thirty, but he does not think that a really small Cabinet of five to seven is practicable or desirable. He believes that a Cabinet of twelve to sixteen, including the principal leaders of the party in power and the principal departments of State, is the best number we could choose, and he questions the value of Ministers without departmental duties as co-ordinators of a group of departments. Such Ministers are without a departmental staff, and confront on their co-ordinating committees a group of colleagues each of whom is supported, if not dominated, by a highly organised department.

There are thus limits to what even a Minister with great drive and skill can achieve in co-ordination in such conditions, and Prof. Wheare cites our experience of the work of the Minister for the Co-ordination of Defence during 1936–40 and the Minister of Reconstruction during 1943–45 in support of his suggestion that such co-ordination should be the task of certain Ministers as chairmen of Cabinet committees of Ministers concerned. In a cabinet of the size he suggests, something more like collective responsibility can be attained. The great evil of departmentalism, the refusal to collaborate or co-operate, can be attacked, while the evil of over-inter-departmentalism, the tendency to collaborate and confer too much, can be curbed.

It will be noted that Prof. Wheare, apart from a reference towards the end of his lecture to the use and functions of advisory bodies, has little to say of the problem of the proper use of the expert, and the relation of fact finding and intelligence to formulation of policy and the execution of policy. He is essentially concerned with this question of control, and having emphasized the place and value of Cabinet control, he explodes the idea of Cabinet dictatorship as contrary to all our experience in the last sixteen years. He cites repeated instances of the influence of the House of Commons on the Cabinet and bureaucracy, and believes that in these last two decades the House of Commons has been at least as effective as it has ever been in the last century.

This is not to say that the control of the House over the bureaucracy both in the legislative and administrative process is adequate. In Prof. Wheare's opinion, a wider use of standing committees for the consideration of Bills is necessary, not to increase the output of legislation but to improve the quality of the House's discussion and control of legislation. He does not entirely agree with the criticism that the control of the House of Commons is inadequate;

rather the opportunities are too few and the House as a whole is not a fit body to give careful consideration to complex regulations. It is his hope that the Select Committee appointed in 1944 to consider clauses in Bills providing for delegation, and also the exercise of the powers so delegated, will obtain in regard to delegated legislation that respect from the bureaucracy which is accorded, in financial matters, to the proceedings and reports of the Select Committee on Public Accounts.

One further suggestion Prof. Wheare makes is in regard to the indirect control of administration by the House of Commons. Direct control of administration is of course the function of the Cabinet, and although the institution of 'question time' provides one effective means of controlling the bureaucracy, it has limits and drawbacks, as has been emphasized in current discussions on the reform of the Civil Service. Prof. Wheare would extend the use of committees, particularly by informal joint all-party committees covering the whole range of administrative activity, to keep in touch with Ministers and with each other and to discuss matters from time to time with departments concerned.

Prof. Wheare does not overlook the importance of control of bureaucracy by the courts of law, nor the questions of decentralization, of the re-organisation of local government and of the recruitment and training of the Civil Service at the local as well as at the national level. These are all questions which he notes as deserving, and destined to receive, study in Oxford, and in particular he is drawn to an analysis of the decentralization of government in the United Kingdom. He hopes to see the study of war government undertaken by a group of those who have had experience in administration during the War, and in his remarks on the value of the new foundation of Nuffield College for the study of government by a system of fellowships, he voices ideas which have much in common with those of Prof. D. W. Brogan[3].

Prof. Brogan's lecture is a lively vindication of the study of politics by the university, which indicates more generally the value of the contribution which the university could make to the theory and practice of government. As he observes, the world expects the universities to have wider interests than the teaching of the young; they exist for the advancement of learning as well as its transmission. He finds sufficient justification for the university teaching politics, and sufficient guide to its methods, in that since politics are being taught by others outside the university, politics had better be taught inside it. But while he points out that the student of political institutions must be purged of the idea that they exist in a vacuum or can be understood apart from other institutions, he insists that the teacher and student of politics in the university has the duty in his teaching and writing, in his encouragement of the teaching and writing of others, of imparting into this double activity as much of the standards of university teaching and research as the nature of his subject will permit. There is nothing in the history of universities to suggest that immunity from passion is inherent in the institution or in its teachers and students, but Prof. Brogan makes the shrewd comment that that weakness arises, in part at least, from the tacit acceptance of the view that politics is not a fit subject for university discussion or for the application of university standards or methods.

Prof. Brogan very clearly takes a wider view of the possible content of the teaching of a university school of politics than Sir William Beveridge did in his farewell address to the London School of Economics; and the trend of his lecture suggests that he does not set himself quite the same ideal of emotional detachment from his subject which comes naturally to the biologist or chemist. At times he seems a little uncertain as to how far politics is susceptible of scientific study, though he is at pains in his conclusion to make clear the contribution to lucid thinking that the mere study of politics in a university must bring. Nor can it be suggested that either Prof. Brogan or Prof. Wheare would not agree with Sir William Beveridge as to the impracticability of combining the service of social or political science and the practice of the arts of democratic government in one person.

The danger is rather that when the scientific study of social or political questions issues in the formulation of a social or political philosophy, that very contact on which Prof. Brogan lays stress tends to identify anyone whose thinking is germane to the problems of the day with political issues from time to time. That danger needs to be kept in mind, not only in studying the problems of government in general and in abstract, but also in considering particular issues, such as the relation of men of science to the task of government. That question, to some aspects of which Prof. H. J. Laski directed the attention of members of the British Association of Chemists last year, is no less actively engaging the minds of American scientific workers; and for all its concern with immediate practical issues in America, Senator H. M. Kilgore's address "Science and the Government" to the Science Society of Washington and the Section on Social and Economic Sciences of the American Association for the Advancement of Science last December (see *Science*, **102**, 629; 1945) merits careful study by British men of science also. Senator Kilgore states that full-time participation in the administrative work of government by scientific men themselves is necessary to enable science to make its full contribution in the service of the State, and he is concerned to discover the most effective type of administration to serve the proposed National Science Foundation.

To a limited extent, a memorandum entitled "The Scientist and Local Government" issued by the Association of Scientific Workers[2] is a contribution to that end. Mr. F. Le Gros Clark opens with a lucid and comprehensive survey of the structure of local government and of the local government services of particular interest to men of science, but then proceeds to discuss very briefly the problem of structural reorganisation and the relation of local to central government. But while he does indicate some of the essential principles of this problem, this part of the memorandum loses some of its value from the

omission of any reference to the various proposals and reports at present under consideration; and the scientific worker who desires fuller information will be better advised to turn to such a memorandum as that issued by the ex-Lord Mayors of Plymouth, Manchester and Bristol—"Local Government Areas—the Boundary Commission: Problems and Opportunities" (Argus Press, Ltd., 27 Tudor Street, London, E.C.4. 6*d*.).

For all that, Mr. Le Gros Clark's pamphlet is worth noting as indicating a field in which the contribution of the scientific man is important and in which its effectiveness depends both on the development of machinery more appropriate to the needs of to-day and on the willingness of men of science themselves to participate in administrative work. Still more, it is important as furthering that task of making understood both the functioning of the machinery of Government and the reasons for Government action and policy. In the light of what has happened recently in regard to the food situation, it should be unnecessary to elaborate the importance of that point further. Mr. Eden was not making merely a party point when he said that Lord Woolton's success at the Ministry of Food was due largely to the fact that at every stage he was very careful to keep the public in his confidence.

This is true both at the central and the local government level, and an excellent report last year from the National Association of Local Government Officers' Reconstruction Committee dealt with the relations between local government and the community. The active and long-term policy of public relations advocated in that report is not one-sided propaganda but a two-way traffic in information and aspirations. The machinery suggested to make local government an effective and fruitful partnership between the citizen, the councillor and the municipal officer includes a national council and local advisory committees, with executive public relations officers to make the mutually educative contact with public opinion through many channels and at the same time to keep a finger on the public pulse.

Machinery of this type is obviously needed in the field of central government, and indeed at the international level, as was noted in the House of Lords debate; but for machinery to be effective there must be the right spirit. It is for that reason that such pamphlets as that of Mr. Le Gros Clark are to be welcomed. The effort must come from both sides. Scientific workers, like their fellow citizens, must take some trouble to understand the machinery of government and the way it functions if they are to be able to make their full contribution to the service of the community; just as the administrator or executive officer, whether at the Cabinet or local council level, the Civil servant or the local government officer, must make some real attempt both to explain the purpose and working of their policy and to understand the mind and desires of the public, including those of scientific workers. Nowhere perhaps will creative thinking be more fruitful than in its application to this problem of developing a really effective intelligence organisation, which will bring administrative policy and executive action into vital and continuous touch with the needs and wishes of the community; for it is the community which the whole machinery of government exists to serve.

[1] The Machinery of Government: an Inaugural Lecture delivered before the University of Oxford, 16 November 1945. By Prof. K. C. Wheare. Pp. 20. (Oxford: Clarendon Press, 1945.)

[2] The Study of Politics: an Inaugural Lecture delivered at Cambridge on November 28, 1945. By Prof. D. W. Brogan. (London: Cambridge University Press, 1945.) 1*s*. 6*d*. net.

[3] The Scientist and Local Government. By F. Le Gros Clark. Pp. 12. (London: Association of Scientific Workers, 1945.) 3*d*.

APPLICATIONS OF X-RAY ANALYSIS TO METALLURGICAL PROBLEMS

An Introduction to X-Ray Metallography

By Dr. A. Taylor. Pp. xi+400+45 plates. (London: Chapman and Hall, Ltd., 1945.) 36*s*. net.

THE investigation of the structure of matter by means of X-rays became possible with Laue's discovery of the crystal diffraction of X-rays in 1912, and following on this, the great pioneer work of the Braggs laid the foundations of the X-ray study of crystal structure. The development of the powder method by Debye and Scherrer in 1915 and independently by Hull in 1916 enabled the structure of very small crystals to be studied, a matter of considerable importance to the metallographer. The subject of Dr. Taylor's new book may be said to have originated with Westgren's paper, "Röntgen Spectra of Iron and Steel", which appeared in 1921. By means of high-temperature Debye–Scherrer photographs, Westgren proved that the α and β forms of iron were identical, and he determined the structure of the γ form. Progress since this date has been immense and, as Sir Lawrence Bragg says in his foreword to Dr. Taylor's book, X-ray analysis has now taken its place beside the classical methods of metallurgy.

After an introductory chapter on the scope of X-ray analysis, Dr. Taylor outlines briefly the fundamental properties of X-rays and describes modern X-ray tubes. He devotes a disappointingly short paragraph to future trends in tube design: more information on developments here would have been welcome, even at the expense of the description of commercially available tubes. In the next two chapters, Dr. Taylor gives a brief but lucid account of the fundamentals of crystallography and the crystal diffraction of X-rays. Chapter 5 describes the experimental methods of obtaining diffraction patterns, the emphasis here being on the Debye–Scherrer camera. An account is given of cameras of this type designed by Dr. Bradley, and much useful practical information on specimen preparation, calculation of lattice parameters, etc., is included. No mention is made of a method of specimen preparation valuable where accurate intensity measurements are required, namely, the compression of metal filings in a mould to form a cylindrical rod, a method which is especially useful for high-temperature photographs. Dr. Taylor goes on to derive quantitative expressions for the intensity of reflexion of X-rays from a powder specimen and describes a microphotometer of the Dobson type which he built for his own work. The photographic processing of X-ray films is not dealt with at all, a surprising omission in

view of its importance in intensity work, nor is there any discussion of the effect of background variation, caused by absorption edges, etc., on the accuracy of intensity determinations.

A further short chapter on the periodic classification of the elements and the crystal structures of the metals completes the introductory portion of the book. Having thus established the technique of his subject, the author devotes the remaining two-thirds of the book to a full account of the applications of this technique to metallographic problems. After discussing the principles upon which the equilibrium diagrams of binary and ternary systems are based, Dr. Taylor explains how the determination of phase boundaries is effected by X-ray methods and gives useful practical information on the heat treatment of powder specimens. He outlines the procedure for the X-ray examination of binary systems, drawing for illustrative examples mainly on his own work and that of Bradley and his collaborators. The formation of normal valence compounds and electron compounds is ably explained: the concept of Brillouin zones is touched upon and is followed by a clear account of superlattices and an outline of the mechanism of the order-disorder transformation. The X-ray investigation of ternary systems is illustrated by reference to the iron-nickel-aluminium system, to our knowledge of which Drs. Bradley and Taylor have largely contributed. An account of recent X-ray studies of the iron-carbon system concludes this chapter on thermal equilibrium. Special mention must be made of the many excellent reproductions of powder photographs which illustrate the chapter.

Chapter 9 is devoted to the measurement of grain-size, and both optical and X-ray methods are described, including the line-broadening method for measuring crystallites less than 10^{-4} cm. in size. The importance of the effects of crystal deformation is emphasized and is well illustrated by a full account of the work done at the National Physical Laboratory on the recovery effect in cold-worked specimens, lattice stress-strain curves and the effects of slow and rapid cyclic stresses. Grain orientation is dealt with in Chapter 10: an account of the principles of stereographic projection is followed by a description of the properties of single crystals, glide phenomena and the fibre structure of cold-worked metals. The pole figure method of representing orientation textures is explained at some length, and the chapter concludes with an account of the use of Laue photographs in the investigation of age-hardening. Chapter 11 deals briefly with the X-ray study of refractory materials and is followed by a chapter on radiography and micro-radiography. The field of radiography is too large to be treated adequately in a few pages, and the omission of this section would not have been serious. The author states that the use of calcium tungstate intensifying screens in radiography gives a two-fold increase in speed: in practice, the increase is much greater than this, as may be seen from Fig. 228.

The book concludes with a list of 120 references cited in the text and an appendix of more than sixty pages containing crystallographic data, X-ray wavelengths, absorption coefficients, etc. This appendix should prove very useful to those engaged in X-ray metallographic work: the values of lattice parameters given in Tables XLIV and XLVI are presumably those obtaining at 20° C., but this is not explicitly stated.

Although several books in English on X-ray analysis have appeared, Dr. Taylor has broken new ground, and he is to be congratulated on writing a text which will be read with profit both by the degree student and by the active worker in the field of X-ray metallography. The volume is well produced and the index is adequate.

R. WILSON WILLIAMS.

MENTAL MEDICINE

The New York Hospital

A History of the Psychiatric Service, 1771–1936. By Prof. William Logie Russell. Pp. xvii+556+12 plates. (New York: Columbia University Press; London: Oxford University Press, 1945.) 50*s*. net.

PROF. W. L. RUSSELL'S book on the New York Hospital fully justifies its subsidiary title—"A History of the Psychiatric Service, 1771–1936"—and gives a full, representative and enthralling account of the development of mental medicine in the United States during the past century and a half, as illustrated in the history of one of its most distinguished hospitals.

For almost fifty years this medical foundation provided the only hospital treatment of the mentally ill in the State of New York, and although with the founding of Bloomingdale Asylum in 1815 the institutional treatment of the insane was destined to proceed in relative independence of general clinical medicine for nearly a century, the fulfilment of a long-cherished aspiration occurred when in 1911 Dr. Russell succeeded Dr. Lyon as medical superintendent and proceeded to develop the closest relations with general medicine in the parent hospital once more. Its history in subsequent years is one of triumphal development towards an ever closer integration of institutional treatment, mental medicine, social services and a special mental nurses' service with the medical and surgical organisation of the great general hospital in New York which presided over its birth so many years before. With the establishment of the Payne Whitney Psychiatric Clinic of the New York Hospital, in 1932, this integration became complete.

Three names stand out towards the end of the eighteenth century in the history of mental medicine. Dr. Philippe Pinel in Paris, Mr. William Tuke, a Quaker merchant, at York, and Dr. Benjamin Rush, of the Pennsylvania Hospital in Philadelphia, were all calling for a release of mental patients from their chains and fetters and the institution of more rational, humane and effective treatment—"measures directed to physical and mental rehabilitation and exercise in wholesome interests and activities". These men were all far ahead of their time, and if alive to-day would appear to be in the very front rank of psychiatric practice, independently of the so-called progress of the last hundred and fifty years.

Prof. Russell ends his story in 1936, and therefore has no cause to mention certain special physical methods of treating mental illness which have become prominent during the past ten years—such as electrical shock therapy, prolonged narcosis, narco-analysis, and that most drastic and hotly debated surgical method of prefrontal leucotomy. These methods are still empirical and lack solid backing in general medical theory. They produce a satisfactory percentage of improved or 'cured' patients among

properly selected cases, it is true; but any *routine* application of such methods is at present to be deprecated, or at least to be carefully watched. The psychological background of all mental cases should have the fullest consideration, and the psychological reaction to such apparently purely physical treatment, especially with reference to the factor of 'transference' between patient and physician, should not be overlooked. All such cases should have the most adequate psychotherapeutic treatment that is available *in addition to* this physical treatment. In the method of narco-analysis, which has recently been used for the recovery of amnesias in war cases and other cases of mental shock, we have really a mere 'second best', only indicated where the services of a skilled psychotherapist, conversant with mild hypnotic and suggestionist methods, are not available. I have never failed to restore functional amnesias by this psychological procedure, both in the War of 1914–18 and in that of 1939–45, and have never experienced the need of an adjuvant drug such as pentothal sodium, intravenously injected, or any similar narcotic. I have also found the condition of 'progressive relaxation', induced by intensive suggestion treatment and instruction in deep breathing, extremely beneficial in certain types of functional nerve trouble, if combined with a certain amount of analytical psychotherapy. It is a psycho-physical, rather than an exclusively psychological, method, and produces by repetition a re-conditioning of the nervous system, especially of the sympathetic nervous system and its peripheral nerves (vaso-motor, etc.), which can be explained in terms of nerve physiology. This method receives no notice in Prof. Russell's book, although psycho-analysis and its derivative variations are briefly mentioned.

"The New York Hospital" is beautifully produced, and is a model of what this type of book should be. It will have an outstanding place among authoritative volumes on medical history. WILLIAM BROWN.

AN ARCHITECT OF THE PRESENT AND FUTURE

An Autobiography

By Frank Lloyd Wright. Pp. iv + 486 + 76 plates. (London: Faber and Faber, Ltd., and the Hyperion Press, Ltd., 1945.) 35*s*. net.

WE have had many autobiographies by successful architects memorable for size of practice rather than principle, and many outpourings of principle from gospellers (Lethaby and le Corbusier stand out) whose actual achievement in building was, or is, alas, pathetically thin—but Frank Lloyd Wright's autobiography is the record of idea and achievement together, both immense in scale and both enriched and confirmed by the continuous experience of half a century. Wright can add to the ideology and the fact of his architecture a personal biography as well charged with romance and passion, and success and failure, in the ordinary terms of human life as any that might be written to record these things alone: the bitterness of his rejection by his colleagues in America, the romances, the vivid portraiture of his friends and enemies, the tragic destruction, twice, of his house by fire and Wright's dogged building of it for the third time. Wright's private life winds as a fascinating and essential thread through the book: it is, however, the parts on Wright's theory and practice that make the book more than just worth reading and put it among the two or three most important books on architecture written within living memory.

The story starts with Wright's childhood as son of Welsh Methodist middle-westerners "imbued with the idea of education as salvation", which explains some part of Wright's own passionate enthusiasm for preaching. Once he had made up his mind to be an architect he became an evangelist not just for architecture in the manner of any good architect, but for the total regeneration and re-definition of 'architecture'; for the integration of technique and expression in contemporary terms and for the evolution of "an Organic Architecture". The phrase is taken from Louis Sullivan, the Chicago architect, and Wright's "lieber meister" and the idea is in part derived from Lao Tze. In its simplest expression it is a battle against the surviving formalism of the Renaissance, "the entire reversal of all pagan—'Classic' ideals of building whatsoever; the reality of building does not consist of walls and roof but in the space within to be lived in". Wright's most complete demonstration of this and perhaps his finest contribution to design has been in house planning by destruction of the Renaissance concept of 'compartments'. "We have no longer an outside and an inside as two separate things. Now the outside may come inside, and the inside may and does go outside. They are of each other. Form and function thus become one in design and execution if the materials and method and purpose are all in unison."

Whereas in much modern architecture the bonds of theory have tightened and a new and more stringent orthodoxy has prevailed, Wright in his whole career has urged a loosening of bonds and in his own work has acted on his beliefs. More vividly than any architect before him he has gone to the root of each problem anew and has shown an ability to make each answer complete, explicit and unique. Of artists living to-day, Picasso only can be said to share this talent. Wright's answer is totally original and totally æsthetic; no technical expedient is left with the raw edges of unassimilated form hanging out—le Corbusier's fault—or is concealed by traditional symbols. His intense and flowing imagination runs as freely in matters of technique as in those of æsthetic. In this he is the complete demonstration of his own theories: as rare a thing as is ever found in architecture.

He has beaten the engineers at their own job time and again; his Imperial Hotel at Tokyo, derided by almost every engineer who knew what Tokyo earthquakes could be, was the only large building to survive the shock of 1921. His latest large building, the Johnson Wax factory offices, gave a sincere and contemporary answer to the problem of designing a large industrial office, and has given us one of the loveliest free fancies of architecture in entirely original terms both technically and æsthetically.

Messrs. Faber and Faber are to be congratulated on their enterprise in publishing this British edition of Wright's "Autobiography"; their confidence may have been prompted by Wright's commentary on the audience for his lectures at the Royal Institute of British Architects in 1939: "On the whole I who have the most intelligent of audiences have never had such a high level of intelligence and fine character in the audience as in London—nor such awareness and purposeful heckling". EDWARD CARTER.

BRITISH NON-FERROUS METALS RESEARCH ASSOCIATION

THE completion by the British Non-Ferrous Metals Research Association of twenty-five years of service to the non-ferrous metals industry was marked by a luncheon in London on November 21, 1945, attended by the Lord President of the Council and the President of the Board of Trade. Speeches made during the luncheon touched on the past history of the Association and the help and encouragement it received from a few enthusiastic supporters in its early days, the work carried out during the last twenty-five years including more recent contributions to the war effort, and the future plans envisaged to maintain its growth and provide an expanding industry with the increased facilities for co-operative research which it will need in the years immediately ahead. The following article touches briefly on the main points under the above headings.

In 1918, about the time that the research association movement was being launched by the Government through the Department of Scientific and Industrial Research, a small group of representatives of the non-ferrous metals industry in Birmingham was exploring the possibility of setting up an organisation which would serve as a technical intelligence bureau for the industry and eventually undertake, if required, researches of general interest which might lend themselves to co-operative rather than individual and possibly redundant effort. The outcome of these discussions was the founding of the British Non-Ferrous Metals Research Association in January 1920. Its income at the start barely amounted to the £2,500 required to secure a share of the grant made by the Government to the research associations, and for the first two years it was maintained only by the enthusiasm of the small group of industrialists who had sponsored the Association. But late in 1922 the wrought brass and copper trade associations of Birmingham added their support, and from that time onwards the Association's history has been one of steady if unspectacular growth.

At first the Association occupied a small office in Birmingham in which it established its library and information department, while its researches were conducted in the laboratories of universities, government departments and member firms. In 1930 the step was taken of centralizing the research work in London, and a laboratory was established in premises near Euston Station. In 1938 a modern laboratory building was erected on an adjoining site and in this the majority of the Association's equipment and its experimental foundry are housed to-day, the older premises having been destroyed by enemy action in 1940. Most of the Association's research work is at present carried out under its own roof, although a small amount of extra-mural work still remains.

In appreciating the work undertaken by the research associations, its relation to that of the universities and of industrial laboratories must be considered. These three types of research establishment provide the research facilities available to industry to-day. Each has a sphere in which it can operate more efficiently than the others, and the contribution of each can only be a part of the total research effort. Industrial laboratories are mainly responsible for the *ad hoc* investigation of practical problems of production. They are necessarily somewhat specialized, being designed to deal with the particular range of processes and products with which the company is concerned. The role of the universities is in the realm of pure science, free from the necessity of considering narrow and immediate needs, but maintaining fundamental scientific knowledge in advance of industrial application. The research associations should properly fill an intermediate position in that their work has a longer range and a more fundamental bias than is possible in most industrial laboratories, while being much more closely integrated with the requirements of industry than is the purely fundamental research work of the universities.

The British Non-Ferrous Metals Research Association's work on melting and casting—a typical research association investigation—is well known to its members, and the results have been given wider circulation from time to time by publication in the technical Press. It had its origin in the early days of the Association in an investigation on the casting of brass ingots. The procedure adopted at the outset of this investigation is of interest as it is typical of the way in which the Association sets about such problems. A survey of existing knowledge was made, coupled with a series of visits to representative works to observe current methods at first hand and to examine in detail the normal products of the industry. Then, after consideration of the information assembled, every aspect of the casting process was thoroughly studied. At the conclusion of the work, recommendations were put forward which, it is not too much to say, have had an important influence on brass foundry practice.

Similar researches have been carried out on sand- and chill-casting in other materials such as bronze, gun-metal, nickel silver, aluminium and magnesium alloys; but the result of this diversity has not been a mere collection of reports dealing with each alloy and its particular casting characteristics. From the results of more than twenty years work in this field, the information gained about the casting process has been distilled into a statement of fundamental principles of the widest application to the casting and solidification of the metals and alloys of all sections of the industry.

The following may be quoted as an indication of the variety of past investigations carried out by the Association: (*a*) The first systematic examination of the effect of small quantities of impurities in copper. The results of this work were summarized in a research monograph which has become the standard work on the subject and is widely consulted and quoted in problems related to the use of this metal. (*b*) The development of the spectrograph as an analytical tool in non-ferrous metallurgy. Since then the instrument has come to be found in a large proportion of the metallurgical laboratories in the industry. The work on spectrographic analysis is also summarized in a research monograph, and like the casting investigation continues to be pursued but with a somewhat more fundamental bias than heretofore. (*c*) The Association's work on atmospheric corrosion revealed for the first time the fundamental role of corrosion films in preventing further corrosion after the initial stages of the attack; and the same feature has since been found in other branches of the Association's corrosion researches to be of vital importance in determining the suitability of a particular alloy for a specific purpose. (*d*) Much work has also been done on the mechanical properties of non-ferrous metals,

particularly lead and lead alloys. Much information on creep and fatigue has been obtained and the B.N.F. ternary alloys of lead were developed to give improved materials to the lead pipe and cable industry. (6) Mention should also be made of the work on tin solders; this forms the subject of yet another research monograph.

Some of the many contributions made by the Association to the war effort were referred to by the Lord President of the Council at the Association's jubilee luncheon, when he announced for the first time some details of the *L*-delay fuze. This is a delayed action fuze about the size and shape of a fountain pen. The principal mechanism is a striker attached to a spring which in turn is attached to a small piece of lead alloy. This small piece is about 7/10 in. long, 3/16 in. diameter and is ground in the middle to a neck to an accuracy of 0·0001 in. When the fuze is armed, the spring applies a load to the piece of lead, which breaks after a predetermined interval of time. In order to obtain exact consistency and reliability of functioning, it was essential that this lead alloy should be of uniform properties throughout, and in particular that the size of the grains that make up the alloy should be controlled very carefully. This work was done by the Association, on the basis of knowledge gained in pre-war researches. As a result, very considerable accuracy was obtained and fuzes timed to go off at times ranging from one hour to one month at normal temperatures were prepared. The fuze was used on every front during the War from 1941 onwards, and can be used either for explosives or incendiaries.

The Association has done much in its corrosion investigations in past years towards the development of new alloys for use as ships' condenser tubes, and research on this subject was intensified during the War. The importance of this work will be appreciated when it is realized that during the First World War a ship's length of service at sea was largely determined by the life of its condenser tubes, the tubes then available being rapidly attacked by the sea water passing through them at high velocity. The aluminium brass and the improved cupro-nickel alloys which have been developed in the Association's laboratories are so greatly superior in resistance to corrosion-erosion that not only are they to-day the standard condenser tube materials, but also their long life enabled a high proportion of our warships to be kept at sea continuously at a time when the Royal Navy was so desperately short of ships.

The condenser tube work was not the only assistance rendered to the Admiralty by the Association. During the War it carried out important work for the Admiralty in connexion with anti-submarine warfare and kindred subjects which involved members of staff participating in operational trials with submarines.

The loss of our most important source of tin in Malaya in 1942 made essential the utmost economy in the use of this metal. It is an important constituent of solder, which has innumerable industrial applications and which is responsible for a large proportion of the annual tin consumption in Great Britain. The Ministry of Supply asked the Association to investigate the possibilities of using solders containing only small quantities of tin or even no tin at all. The properties of these war-time solders and the problem of using them in place of the old tin-rich solders were studied in great detail. The Association, in co-operation with its member firms, also established a Solders Advisory Panel to help users of solders with their 'tin-economy' problems. British industry did, in fact, effect a tremendous economy in the use of tin in solders during the years following the fall of Malaya, and the Ministry of Supply has acknowledged the substantial contribution to this achievement made by the Association's work.

Another war-time problem in which soldering and other methods of jointing metals were involved related to the construction of radiators, oil coolers and charge coolers for Service aircraft, failure of which usually resulted in engine breakdown. The conditions under which these coolers may be safely worked depend mainly on the strength of the joints. On the other hand, improved engine performance involves increase in working temperature and pressures for these coolers, and the problem was to increase the strength and maximum operating temperature of their joints. Work on soldering and brazing methods done by the Association in collaboration with its members made possible the use of the higher temperatures and pressures required. The charge intercoolers which were a feature of the improved Merlin 61 engine, details of which were released to the public at the end of 1942, embodied these improved methods of construction.

In the light alloy field the Association did valuable work on the treatment of scrap aluminium alloys and in obtaining information for aircraft and other designers on the properties of these alloys.

By the work already carried out, the Association has amply proved its worth and has established for itself a permanent position in the research field for the non-ferrous metallurgical industry. A careful examination of the situation has, however, revealed the fact that if it is going to provide the full service the industry needs, the scale of the Association's operation must be increased. It is not possible in a small organisation to provide that variety of expert staff, equipment and service which the industry requires. Metallurgy is not in itself a pure science which can be dealt with entirely by qualified metallurgists, but is based on chemistry, physics and engineering, all of which must be adequately represented by departments within the Association's organisation.

A review of the research field before the Association shows an enormous amount of work still to be done, and the Council has decided on an extension of the Association's activities to almost three times that on which it has been operating during the War. It is particularly desirable to provide, through the Association, machinery for carrying out researches on problems common to different sections of the industry to a stage at which the fundamental knowledge on which a particular process is based is amply established. For example, in the field of melting and casting, work on aluminium, magnesium and copper-base alloys is being extended to include a study of the fundamental problems of heat transfer in moulds of different types and the mechanism of grain refinement in different materials. In the field of corrosion resistance, work on practical problems in marine corrosion and a study of the resistance of non-ferrous metals and alloys to corrosion in domestic water systems is being continued, not only from the practical point of view but also with the additional object of studying in particular the basic causes of the development and rapid growth of pits in certain corrosive conditions.

An important section of the work is that on stress corrosion, and research at present in progress on the occurrence of this phenomenon in high-tensile brasses, aluminium-base and magnesium-base alloys is being co-ordinated with the simultaneous objectives of elucidating the behaviour of particular materials under certain conditions and of providing a basic understanding of the mechanism of stress corrosion without which the behaviour of different materials in service can never be adequately understood. Similarly, in the case of the jointing of metals, the researches mentioned above on soldering have provided information of a practical nature on the relative merits of different solders in certain applications, but the basic factors underlying the soldering operations are not understood. The Association's investigation is being deflected into a study of these factors, without knowledge of which further practical advances can only be on a hit-and-miss basis.

Other examples could be quoted, but those described illustrate the type of work which is appropriate to the British Non-Ferrous Metals Research Association and on which it will concentrate more and more in the future as the realization of its expanded programme becomes possible. It is not intended that the Association should abandon the study of practical problems in favour of fundamental ones, but that the two aspects should be combined by carrying work on questions of practical importance to a stage at which the fundamental principles underlying the phenomena observed are fully understood.

CYTOLOGY, BIOPHYSICS AND BIOCHEMISTRY

ON November 10, the Biochemical Society held a discussion meeting under the general title "The Chemical Basis of Cell Structure and Function". The main contributors, in order of speaking, were Dr. J. F. Danielli, Dr. J. H. Schulman, Prof. W. T. Astbury, Dr. E. Stedman, Dr. J. N. Davidson and Prof. E. J. Conway.

Dr. Danielli said that the task of building up a dynamic picture of the cell, even at the chemical level, involves knowledge of the permeability of the plasma membrane, the cytoplasm, the nuclear membrane, the nucleoplasm, and the various other formed bodies and organs of the cell, such as granules, vacuoles and mitochondria. At present we have a great deal of information about the permeabilities of the plasma membrane, and a considerable knowledge of the permeability of the ground substance of cytoplasm, but otherwise there are few facts available. The permeability of the ground substance of cytoplasm is high: the resistance to diffusion within it, for molecules up to the size of Trypan blue, is not much greater than that encountered in water. The permeability of the plasma membrane is often very low: the rates at which different molecules penetrate a given membrane differ enormously, and cells of different types and differing species exhibit very large differences in permeability to the same molecule. However, when the permeability of a cell to, say, three or four different molecular species is known, it is usually possible to calculate the order of magnitude of the permeability to most other molecular species. The mechanism of penetration through the plasma membrane was discussed, and it was pointed out that further advances in this part of the field are held up by the inadequacy of present-day theories of diffusion.

Of certain aspects of plasma membrane permeability we are still almost completely ignorant: these aspects include permeability to large polar molecules, such as proteins, and to large non-polar molecules, such as fats and sterols. As yet practically untouched are all secretory processes—that is, all those activities of the cell involving the movement of molecules by processes other than simple diffusion.

Dr. Schulman discussed lipo-protein associations, as revealed by the study of emulsions and monolayers. If a globular protein is brought into contact with a lipoid at an interface, it will unroll if association takes place. *In vitro* complete reversal of this unrolling process is very difficult, but the suggestion was put forward that *in vivo* reversal may be more readily achieved. Dr. Schulman said that in his experiments there is a marked tendency for the adsorption of proteins to be influenced by the sign of charge of the protein and of the lipoid surface. When the surfaces are of opposite sign of charge, vigorous adsorption of protein takes place, whereas when protein and lipoid have the same charge, often no adsorption occurs; in fact, if a protein on the acid side of its iso-electric point is allowed to become adsorbed on a negatively charged interface, and then the *p*H is shifted so as to make both surface and protein of the same sign of charge, desorption of protein will often occur. The desorbed protein may be monodisperse.

When the monolayer technique is used to study protein-lipoid association, it is convenient to spread a monolayer of lipoid, and inject protein into the underlying aqueous phase. If the protein penetrates the lipoid film, this is reflected by changes of surface pressure, surface viscosity and surface potential. In this way it can be shown that cholesterol absorbs many proteins very strongly. Lecithin has not so far been found to absorb any protein over the physiological *p*H range. Kephalin associates with some proteins at *p*H 3·7. With long-chain amines, association appears to depend in part on the length of the paraffin chain of the amine.

Prof. Astbury pointed out that, although the fine details of protein structure remain to be elucidated, some of the broader outlines are now beginning to appear. Two broad groupings of proteins have appeared in the light of physical studies: the keratin-myosin-fibrinogen (k.m.f.) group and the collagen group. These groupings exist despite marked variation in amino-acid composition within both groups. The k.m.f. group is distinguished by long-range elasticity, based on a particular method of folding of the main polypeptide chains of the protein: it now appears probable that the side chains are closely packed, with polar chains lying on one side and non-polar chains on the other side of the main chain. The basic plan for synthesis of the k.m.f. group is a standard plan apparently possessed by cells of highly diverse types; the details of this plan can be adapted to a variety of ends, as the processes of differentiation demand.

The proteins of the collagen group have their polypeptide chains extended in a manner differing from that which occurs in the k.m.f. group. The analysis of this has not proceeded so far as for the k.m.f. group. It is, however, possible that reticulin connective fibres have a structure which is intermediate between that of the two groups.

The impression given by combining X-ray and electron microscope studies is of successive levels of organisation. For example, with X-rays one of the repetition units is as large as 640 A., and Schmitt and his colleagues, using the electron microscope, have demonstrated a corresponding system of light and dark bands in fine collagen fibres. We must regard fibrous proteins as built up first of amino-acids combined to form larger units, which in turn form part of larger units, step succeeding step until the fibril and combination of fibrils of the microscopist are attained. In the building of these larger structures, small amounts of non-protein components may take an essential role; it is therefore necessary to estimate the proportions of such substances as sugars and nucleotides in proteins with much greater precision than hitherto.

Dr. Stedman said that whereas the nuclei of salmon sperm contain protamine and no histone, the somatic nuclei of salmon contain histone and no protamine: in consequence, neither protamine nor histone can provide the chemical basis of genetic activity. Nucleic acid and the acidic protein chromosomin are the remaining constituents of cell nuclei which must be considered. Nucleic acid, in his opinion, appears to be of invariable composition, and therefore cannot convey genetic activity, but probably forms part of the nuclear sap. But chromosomins, which appear to be a universal constituent of cell nuclei, probably have this function.

Chromosomins, unlike histones, are rich in tryptophane. At present they can only be isolated in the denatured condition. The chromosomins so isolated should be strictly comparable to the characteristic sectioned or smeared material of the cytologist, which also is denatured. It is therefore of great interest that denatured chromosomin has staining properties closely resembling those of chromatin. In Dr. Stedman's opinion the basic proteins (protamines and histones) probably form part of the cell sap, and are of importance in the control of cell proliferation.

Dr. Davidson summarized much of the recent work on cytoplasmic ribonucleoproteins. Strictly, this material should be referred to as pentose nucleoprotein, since the pentose has been identified as ribose only for the polynucleotides of yeast and liver. Brachet first described the ribonuclease test for ribonucleic acid: in this test, tissue sections are treated with purified ribonuclease, which attacks ribonucleic acid but not deoxyribonucleic acid (found almost exclusively in cell nuclei). Material which stains with such basic stains as pyronine and toluidine blue, and is removed by this enzyme action, is taken as ribonucleic acid.

Adult liver cells, when centrifuged, exhibit four strata: the heaviest material is glycogen, the next stratum contains the nucleus and large particles including mitochondria, the third layer chromophilic ground-substance and the lightest layer true hyaloplasm. When disintegrated cells are separated into fractions by differential centrifugation, two main sizes of particle are found containing ribonucleoprotein. The larger (0·5–2μ) are believed to be the mitochondria and secretory granules, and the smaller microsomes (50–200 mμ) to be the chromophilic ground-substance.

In contrast, in the chick embryo, yeast, amphibian eggs in development and in young oocytes, it is reported that 60–80 per cent of the ribonucleic acid is not sedimentable in the ultracentrifuge. There is much evidence that cytoplasmic ribonucleic acid is closely connected with metabolism, and the view has been advocated by several authors that cytoplasmic ribonucleoprotein particles are organs responsible for protein synthesis.

Prof. Conway presented an analysis of the distribution of inorganic constituents of cells, with particular reference to muscle cells. The most interesting aspect of this was the recent work from Prof. Conway's own laboratory, in which it has been shown that, subject to certain assumptions, ions distribute themselves across the muscle fibre membrane according to the Gibbs–Donnan equilibrium. The assumptions are that the muscle membrane has pores permeable to hydrogen ions, potassium ions, and small anions, but not to sodium ions and large anions. With these assumptions it follows that, as a cell grows, potassium ions will be automatically accumulated in the cell as phosphate esters, and proteins are synthesized. If these assumptions are justified, we must assume that such ions as calcium and magnesium, being larger than sodium, will also be unable to enter through the membrane pores. But they will be able to form un-ionized complexes with, say, cell membrane lipoids, and then penetrate into the cell in this form.

In the ensuing discussion many points were raised, among the more important of which were that emphasis must be laid on the lack of satisfactory evidence that nucleic acids are chemically homogeneous, and that doubt must be felt as to whether muscle cell membranes are in fact impermeable to sodium ions. Until the constitution of the nucleic acids is more precisely defined, it will presumably be difficult to fix limits to their potentialities *in vivo*.

With regard to the permeability of muscle fibre membranes to sodium ions, it is difficult to come to any final conclusion without studies with isotopic sodium: the position at present may be construed as involving either a complete impermeability to sodium ions, or else that the cell actively extrudes them as fast as they enter. However, in view of what is already known about permeability to ions, it seems highly improbable that significant amounts of sodium will not penetrate into muscle fibres, if a period of, say, years is considered: yet in fact the ratio of sodium to potassium remains unchanged for years.

We must therefore regard it as probable that the sodium ion is actively extruded by muscle, and probably by many other cell types.

Considered as a whole, this discussion revealed several trends. First, it is apparent that the examination of the chemistry of biologically important molecules has reached a point at which it is possible, desirable, and necessary to obtain more information about cytochemical distributions: the biochemist can now begin to piece together the chemical fragments of cells with which he is familiar, and develop an understanding of how they are organised in the interests of the processes of life. Secondly, the general picture of the globular protein molecule now forming is one which is satisfactory to those using many different modes of study, and one which is acceptable to the cytologist. Thirdly, while *in vitro* studies of biologically important molecules can often profitably proceed quite independently of biophysics, when the biochemist turns from the analytical to the constructive sphere, the inexorable necessity for a concomitant physical approach becomes plain. For the study of the living cell, even at the simplest level of organisation, a marriage of true minds, the physical and the chemical, is essential. Let us admit no impediments to this.

J. F. Danielli.

TROPICAL MEDICINE IN THE BRITISH EMPIRE

THE PRESENT POSITION IN LONDON

By Sir PHILIP MANSON-BAHR, C.M.G.

NO one can belittle the weight of responsibility which falls upon the British Colonial Empire at this moment, especially in respect to the health and well-being of those millions of primitive peoples entrusted to its care. In 1909 the late Sir William Osler put this matter admirably in these words: "When Isaiah was discussing the burden of Babylon, the burden of Tyre, and the burden of Egypt, I wonder what he would have said could his prophetic eye have glanced at the map on which is depicted the burden of the British Empire. Surely no nation in history has ever had such a load of responsibility. But fit as it has been in the past, it will ever be fit as long as *salus populi* remains *suprema lex*. It only behoves us to see that we are well-equipped for this second great task—the task of the future, to give the teeming millions of our dependencies that greatest of all blessings in life—good health".

A large portion of the Colonial Empire is situated within the tropics in Central Africa, in the West Indies, South America, Malaya and the Far East. There is also the overpowering problem of India, where the conditions are eminently suitable for the spread of diseases peculiar to hot climates.

In the basic discoveries in this branch of medicine British men of science have played a dominant part, and their achievements have been, during the last fifty years, second to none. It is scarcely necessary to recapitulate the achievements of Sir Patrick Manson, who led the way by the discovery of insect-borne disease from 1879 onwards, culminating in the elucidation of the malaria-mosquito problem by Ronald Ross in 1897. This was indeed the golden age of British tropical medicine, and as the result of these researches tropical medicine came to be established as a specialized subject. The unstinted support of Manson for his pupil Ross, as he then was, is well exemplified in the letter addressed to Sir Charles Crosthwaite at the India Office in July 1897:

"So convinced is Ross of the truth of this mosquito theory that lately he took three months' leave and retired to the most unhealthy place he could get access to, to work on the mosquito. He was three months there and got a lot of knowledge, and also a dose of malaria. . . .

"It would be a vast pity if the chance which now presents of making a substantial addition to pathological science should again be lost to Englishmen. We are cutting a sorry figure alongside other nations just at present. To our national shame, be it said that few, very few, of the wonderful advances in the science of the healing art which have signalized recent years, have been made by our countrymen. This is particularly apparent in the matter of tropical diseases, in which we should in virtue of our exceptional opportunities, be *facile princeps*. But, even in tropical diseases, Frenchmen, Italians, Germans, Americans and even Japanese, are shooting ahead of us.

"We have to get a Koch to find for us the cholera germ, and a Haffkine to protect us from it; a Laveran to teach us what malaria is, a Kitasato to show us the germ of plague, and a Yersin or a Haffkine to cure us of its effects. This is very humiliating to everyone but a cynic. But in this matter of malaria here is a chance for an Englishman to rehabilitate our national character and to point out to the rest of the world how to deal with the most important disease in the world—malaria.

"This is not bunkum, but fact. If we don't do it, and do it soon, some Italian, or Frenchman, or American, will step in and show us how to do what we can't or won't do for ourselves. They are on the track, even now. Can you influence the powers that be at the India Office to give Ross the chance of striking a good stroke for England? He asks for little, and may do a great deal indeed."

British Achievements in Tropical Medicine

These warnings were soon taken to heart, and a whole series of striking discoveries redounded to the credit of British science. There came David Bruce and with him the unravelling of the mysterious sleeping sickness, or negro lethargy, of Central Africa. In 1896, he was the first to associate a trypanosome (*T. brucei*) with the nagana disease of horses, cattle and big game and the presence of noxious tsetse flies. The immediate result of this work was to lay bare the enormous unexplored field of trypanosome diseases and to stimulate research on tsetse flies. It culminated in the discovery of trypanosome disease in man by Forde in 1901 and the naming of the parasite, *Trypanosoma gambiense*, by Dutton in 1902. History will record that the final solution of the sleeping sickness problem should also be awarded to Bruce for his work in Uganda in 1903.

Complete understanding of this major scourge of the African Continent would have been impossible without the painstaking work of many medical entomologists, among whom Austen is rightly regarded as a pioneer.

The riddle of 'tick fever' which killed David Livingstone was solved by Dutton who, in association with Todd, proved that it was conveyed by the Central African tick, *Ornithodorus moubata* (1905). Two years later, F. P. Mackie showed that the louse was the vector in that variety of relapsing fever occurring in India. This discovery undoubtedly stimulated interest in this lowly insect and indirectly led to its incrimination by Nicolle in the spread of typhus at a later date.

In the front rank we must also place the identification of the Leishman–Donovan body by Leishman in 1903 which thereby led to the recognition of the group included under the term leishmaniasis. It is to Leiper that we mainly owe the disentangling of the complicated life-history of bilharzia and the recognition of the two main human species of this parasite in 1915.

The introduction in 1912 of emetine in the treatment of amœbiasis and of antimony in kala-azar in the following year was a prime therapeutic contribution by Sir Leonard Rogers. These are but a few of the outstanding British achievements in tropical medicine.

Education in the Principles and Practice of Tropical Medicine

The foundation of schools for research on tropical diseases and special teaching of this subject arose primarily from the precepts of Patrick Manson. The London School, which was his child, opened its doors at the Royal Albert Dock in 1899, almost simul-

taneously with its sister school in Liverpool which owed its inception to Sir Alfred Jones. Manson's School was modelled on the idea of a tropical centre. There were teaching and research laboratories, animal houses, residential quarters and a hospital for patients suffering from tropical diseases, all in intimate association—an ideal arrangement. From the commencement, with Manson's guidance, the scheme proved a success, and the London School of Tropical Medicine, under the ægis of the Seamen's Hospital Society, flourished in its somewhat remote and dingy surroundings for nearly twenty years. As the result of the First World War and, in accordance with a desire to see tropical medicine established in the University quarter of London, the decision was taken to transfer the School to Endsleigh Gardens, in the neighbourhood of Euston, in 1919. The new quarters were adapted to the purpose, and could not be considered very suitable, situated as they were in a building designed primarily for a private hotel and used as an officers' hospital during the war period.

The stay of the School in its new surroundings was a brief ten years, for in 1929 it was merged into the newly instituted London School of Hygiene and Tropical Medicine, at which time the nucleus created by Manson lost its identity as a separate unit. It also led to the separation of the clinical from the purely laboratory and scientific activities. This was regarded by many at the time as a retrograde step and the fruit of this policy is to be seen in the present rather deplorable situation. The Hospital for Tropical Diseases continued to function in the Endsleigh Gardens building as a separate entity under the Seamen's Hospital Society and permitted the number of beds to be increased to seventy-five. As such it continued to do good work and to meet a definite public demand. Clinical and pathological material from the Hospital was utilized for teaching purposes for the student classes from the School of Hygiene and Tropical Medicine.

Rumours of war then darkened the skies above Bloomsbury and in August 1939, a week before the declaration of hostilities, the Hospital for Tropical Diseases was evacuated by order of the Government as unsafe and dangerous. The equipment was dispersed to many centres and its staff scattered to the winds. That these fears were justified is seen by the partial destruction of the building by enemy action in 1941. No provision could be made for the treatment of tropical cases in any other hospital or centre in London, and it is a matter of sincere regret and very considerable inconvenience that no facilities for sufferers from tropical diseases have existed in London during these six years of war. However, steps are now being taken to set up a separate hospital for this purpose early this year. It is hoped that this small refuge will constitute the seed from which an institution more worthy of the greatness of the British Empire and its tropical dependencies will eventually germinate. It will, at any rate, serve to anchor the main interests in clinical tropical medicine in the Metropolis until more favourable opportunities present themselves, for it is hard to believe that, though we have more Colonial possessions than any other country, we are now perhaps the least well equipped to teach young men the treatment of these tropical diseases they are most likely to encounter in their service overseas. It is a matter of common knowledge that such countries as Holland, Belgium and Italy had far better equipped tropical hospitals than anything in Great Britain, and that the best example of all was to be found in Hamburg in a Germany even when bereft of all its tropical colonies.

Undoubtedly some voices will be heard declaiming that the most suitable place to impart clinical instruction in the diseases of the tropics is in some medical centre situated within the torrid zone[1]. This is undoubtedly desirable, but it is scarcely practicable under the present conditions. It has been proved possible in the past—in London at any rate—to provide adequate clinical material for teaching the main tropical diseases, such as malaria, dysentery, sprue and their sequelæ.

It will no doubt be possible in the future for particular students to specialize in tropical medicine and hygiene as consultants. They should be permitted to hold approved hospital appointments in tropical countries as part of the prescribed post-graduate experience in this branch of medicine, as foreshadowed in the Goodenough Report.

Discoveries and Achievements in Tropical Medicine during the War

Let us now examine some of the recent achievements in this vast field and the opportunities they present to future workers in the British Empire. There is much food for thought here, as well as subjects to attract teams of research workers from the London School of Tropical Medicine, the Medical Research Council and other bodies who may be dispatched to different parts of the tropics, to investigate some particular pressing problem.

The introduction of the sulphonamide drugs has exerted an enormous influence on tropical therapeutics. There is, for example, the almost magical influence of sulphapyridine on pneumonia and cerebrospinal meningitis, both of which constituted terrible scourges to primitive peoples. Sulphaguanidine and sulphasuccidine, less soluble products of sulphapyridine, introduced in 1941, when promptly and scientifically administered, have proved most effective in the treatment of bacillary dysentery, with the result that the incidence of this disease has been reduced to minimal proportions, so that, as a war menace, it has practically disappeared. It is stated that the mortality rate, formerly considerable, has now been reduced to less than 1 : 5,000[2]. Many medical officers have recorded series of cases of 700 or more without a single fatality.

The potentialities of penicillin in the treatment of many tropical infections are coming to be appreciated, and it is scarcely as yet possible to estimate how far its benefits may extend. In yaws, that universal and maiming affection of the tropics, this wonder drug appears to produce results as magical as in its sister-disease—syphilis.

Thus Whitehill[3] and Austrian[4] have treated seventeen cases of active primary and secondary yaws with intramuscular injections, in doses of 15,000 units four-hourly day and night for 5–6 days. The spirochætes were observed to disappear within sixteen hours. All lesions had completely healed within three weeks. These sensational results have been confirmed by Findlay, Hill, Macpherson[5], Lofgren[6] and others.

Equally favourable are the results reported in tropical ulcer. This is notorious as one of the most disabling diseases of primitive peoples. The incapacity it brings about is enormous, and the destruction it causes of the tissues and even of bone frequently makes amputation inevitable. Many of the ulcers so treated were of several months' standing. They were treated by injection of 100,000 Oxford units and the

application of penicillin ointment, with the result that the highly septic ulcers had become practically sterile, and healthy granulations had filled their bases.

There is also the parallel action of penicillin on other spirochætal diseases. According to Eagle and Magnuson[7], injection of penicillin causes rapid disappearance of the relapsing fever spirochætes in artificially infected rats and mice. Their results seem to indicate that this treatment should also be effective in man. This is important as the present mode of treatment by arsenotherapy has been considered unsatisfactory during these war years. On the organisms (*Spirilla*) of rat-bite fever similar results have been obtained, while in the leptospiroses—Weil's disease, seven-day fever, etc.—Alston and Broom[9] and Cross[10] indicate that the therapeutic results should be equally favourable.

In malaria great and solid additions to knowledge have been achieved mainly as the results of the work of Hamilton Fairley[11] (who in peace-time is physician to the Hospital for Tropical Diseases and lecturer in the London School of Hygiene and Tropical Medicine) and which must be assessed as of great merit. The researches which have now been published were rendered necessary by the alarming incidence of these fevers among combatant troops in the South-West Pacific.

The mode of action and precise value of anti-malaria drugs, including the sulphonamides, mepacrine (atebrin) and quinine, were tested out thoroughly, when used both as suppressants and true causal prophylactics in more than a hundred volunteers (from the Australian Forces) who had been infected with the Papuan strains of benign tertian (*Plasmodium vivax*) and subtertian malaria (*P. falciparum*). These volunteers were exposed, while taking anti-malaria drugs, to bites of malaria-infected mosquitoes. Similarly, the experiments were so planned that volunteers were exposed during suppressive treatment to rigorous conditions, including heroic exertions, physical hardships and exposure to altitudes of 15,000–18,000 ft. in aeroplane flights, without provoking relapses of malaria.

Large doses of malaria-infected blood, ranging from 10 to 200 c.c., even 500–800 c.c., were utilized to produce infection or, even, sometimes to prove that malaria parasites were absent after spells of treatment.

Many positive facts of decisive importance which may profoundly affect our knowledge of malaria have emerged. It has been shown, for example, that when bitten on one arm by an infected anopheles mosquito, the blood taken from the opposite member becomes infective to another volunteer within as short a period as seven minutes, but that afterwards, in the cases of malignant malaria (*P. falciparum*), the blood remains incapable of transmitting further infection for a period of seven days, while in benign tertian this span lasted as long as nine days.

From these premises and others of a similar nature it is argued that the malaria parasites of man may undergo (like those of certain malaria-like parasites of birds—*P. gallinaceum*[12] and *P. cathemerium*) an intracellular development in the endothelial cells of blood vessels prior to entering the red blood corpuscles. This would go far to explain the *raison d'être* of the prolonged latent periods and remissions which characterize the human malaria infections, and would postulate that a further complication has to be added to the known and already complex cycle of development of the malaria parasites. Field experiments definitely proved the practical value of suppressive antimalaria drug treatment, especially that of mepacrine (atebrin), in doses of 0·1 gm. daily in volunteers, though bitten repeatedly over several months by anopheline mosquitoes, infected with both species of local malaria parasites—*Plasmodium falciparum* and *P. vivax*. This amount of mepacrine was found to be quite harmless to the volunteers and in no way incapacitated their well-being. A vast amount of work was devoted to the amount of this drug absorbed into the blood serum (blood levels) necessary to cause suppression of the parasites and it was found that the effective level was not reached until the drug had been taken continuously for 9–10 days. It thus became evident that any reduction of the standard suppressive mepacrine to three or four tablets weekly would result in attacks of overt malaria in those who had been artificially infected.

It was this ineffective method of uncontrolled mepacrine prophylaxis which accounted for those disastrous epidemics of malignant malaria in the severe jungle fighting in the earlier stages of the campaign in New Guinea and Burma.

The net result of these researches was to convince the General Staff of the inherent soundness of mepacrine prophylaxis as applied to combatant troops in the field, so that it was decided to make this subject a disciplinary measure. The success of this ruling was immediately seen in the reduction of the malaria rate from 740 per 1,000 per annum in December 1943 to 26 per 1,000 per annum in November 1944. Furthermore, for the two years prior to VJ Day, the death-rate in the Australian Military Forces for uncomplicated malaria has not exceeded 1 : 3,000 cases[5]; although perhaps other factors have combined to produce these favourable results, such as improved anti-mosquito measures and less severe exposure to infection. These figures must be regarded as the outcome of a splendid achievement.

Prevention of Insect-Borne Disease

The facts stated above must be interpreted in the light of advances in the field of malaria prevention as well as that of other insect-borne diseases by an entirely new weapon, more efficient than any hitherto employed, which has been provided by D.D.T. (dichlor-diphenyl-trichlorethane), the possibilities of which have been tested out on a considerable scale by Prof. P. A. Buxton[13] of the London School of Hygiene and Tropical Medicine. This substance is fortunately, in moderate doses, harmless to man and animals, nor is it irritating to the skin. D.D.T. is a white crystalline powder which possesses a faint, pleasant odour, is non-volatile at ordinary temperatures and dissolves in most ordinary solvents. D.D.T. is probably poisonous to nearly all insects, though the lethal dose varies greatly in various species. The actual dose which kills is exceedingly low, because it kills flies and other insects which have touched dry surfaces impregnated with it with their feet only. It acts apparently on the nervous system, and its action on mosquitoes is most effective in sprays combined with pyrethrum extracts, especially in the form of the 'freon' or aerosol bomb, made by the Westinghouse Company. When the release of this bomb is opened, a mist escapes which has remarkable powers of penetration into small refuges where these insects shelter.

Adult anopheline mosquitoes can be reduced in numbers for as long as 2–3 months after a single spraying in houses. Films spread on the walls are

most effective. When a mosquito enters a house and rests on the wall before attacking man, it picks up enough D.D.T. to prevent its biting. It may also be impregnated on to wide-meshed bed nets, thus rendering them effective barriers against mosquitoes and sandflies. It would also appear probable that the use of D.D.T. may solve the problem of insect transmission by planes and thus prove a safe and, withal, simple measure in combating yellow fever. Against mosquito larvæ it is equally effective, though for this purpose it will be necessary to produce a floating, non-wettable powder containing a sufficiency of D.D.T. At present it is most effective when dissolved in the customary larvicidal oils, by spraying pools and other collections of water containing mosquito larvæ. It is equally effective on that universal pest, the house fly, and when sprayed in kerosene emulsions on various biting flies which plague cattle and other domestic stock; but, most important of all, it has been found by Buxton and Nash that the vicious and dangerous tsetse (*Glossina*) of Central Africa is readily killed by traces of D.D.T. on cloth or on the hair of animals. This method opens up great possibilities in the control of the tsetse, which have so far resisted every other measure to exterminate them. The discovery that they may be either exterminated locally or greatly reduced in numbers by the employment of herds of bait animals, or by impregnating clothing, is obviously of prime importance to the future of Central Africa. The general adoption of these comparatively simple measures should enable domestic animals—cattle, horses and pigs—to thrive in many areas where it was impossible for them to exist on account of the trypanosome diseases conveyed by the tsetse fly.

The impregnation of clothing with D.D.T. for the suppression of lice was one of the major discoveries of the War. When properly applied to shirts it can resist many washings and this fact has resulted in protecting our troops from the ravages of these pests which proved such a disgraceful feature of the First World War. The method of application of D.D.T. in dust by handblowers, by puffing up the sleeves and trouser legs or down the neck and into the waist of skirts and trousers effectively delouses a whole population in a short time. This is the method which was employed in one of the most remarkable pieces of preventive medicine yet recorded, namely, the typhus epidemics in Naples early in 1944.

D.D.T. also acts on bed-bugs, cockroaches and on some species of tick.

Enough has been said to indicate that this new discovery has placed in our hands a weapon of immense importance. Its influence upon health and comfort in the insect-ridden tropical and sub-tropical lands is bound to be great and it will probably have far-reaching effects upon colonization and development of the British tropical Empire.

The future of tropical medicine is therefore bright. There are still immense, almost limitless, fields to explore and conquer. Verily the harvest is plenteous and the labourers are few, but those who are in a position to know are much perturbed about the present position of tropical medicine in London. Obviously something will have to be done to preserve the ideals of Manson's School. That they should crumble and die is unthinkable.

It can reasonably be urged, in these days of imperial aid for colonial development and of increasing Empire-mindedness of the British Parliament and of the British people, that more whole-hearted support should be forthcoming so as to create in this, the Metropolis of the British Empire, a world centre for the study of tropical diseases, worthy of its greatness and of its glorious heritage and to keep the flag of tropical medicine flying where it ought to be, in London. Such a tropical centre should be remodelled on the lines of Manson's original School with a Hospital for Tropical Diseases, the School of Tropical Medicine with its special departments of protozoology, helminthology and entomology in close association with one another. In view of the remarkable achievements in tropical hygiene—one of the most outstanding victories of the Second World War—this section will have to play a leading part. Special emphasis should be placed upon the desirability of founding a hostel in connexion with the centre where students from overseas can be housed and made to feel at home in the somewhat, to them, forbidding surroundings.

Colonial governors are well aware of the prestige that scientific medicine brings in its train and that the almost instantaneous and magical effects of some of the modern drugs (mentioned in this review) do more to enhance respect in the minds of illiterate people for British administration than almost any other measure.

It therefore becomes incumbent on the British Government to encourage and foster, as it undoubtedly will, tropical medicine as an essential part of Colonial policy.

Let us see to it, therefore, that our young men returning from the wars to take up this most important branch of medicine are given the tools to get on with the job.

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OBITUARIES

Dr. A. C. Oudemans

SINCE communication has been established with Holland, we have heard from Dr. G. L. van Eyndhoven of the death, at the age of eighty-five years, of Dr. A. C. Oudemans. He died at Arnhem on January 14, 1943.

Dr. Anthonie Cornelius Oudemans, a son of Prof. J. A. Chr. Oudemans, chief engineer of the Geographical Service of the Dutch East Indies, was born in Batavia on November 12, 1858. He came of a gifted family some members of which held important positions, usually of a scientific nature, in the Dutch East Indies. In Holland, two of his uncles were distinguished men of science: Prof. A. C. Oudemans as a chemist and Prof. C. A. J. A. Oudemans as

botanist and mycologist, while his cousin, Dr. J. Th. Oudemans, was president of the Dutch Entomological Society for many years.

At an early age, Dr. Oudemans was sent from the Dutch East Indies to Holland and received his education at the High School at Arnhem and at the University of Utrecht. Some years later he returned to Arnhem High School as a teacher, and remained there until his retirement at sixty-five.

From the age of twenty-one, when Oudemans published his first paper, until two years before his death, he wrote 584 papers for publication. The greater number of these were comparatively short works of a systematic nature, mainly on the order Acari (mites and ticks) of the class Arachnida, but scarcely a phylum in the animal kingdom escaped his notice, and in his earlier years he published many papers on the vertebrates. His interest in plants was considerable and he wrote about a score of papers of a botanical nature.

Among his best known publications is his book, written in English, on "The Great Sea-Serpent. An Historical and Critical Treatise with the reports of 187 Appearances (including those of the Appendix), the Suppositions and Suggestions of Scientific and Non-scientific Persons, and the Author's Conclusions" (Leyden: Brill; London: Luzac; 1892). This work he very aptly dedicated to "Owners of Ships and Yachts, Sea Captains and Zoologists". His interest in the 'sea-serpent' was maintained all his life, and when the so-called 'Loch Ness Monster' made its erratic appearances in the waters of that northern loch, Dr. Oudemans wrote some further notes on the subject during 1934–35.

He is also remembered by many zoologists for his studies on the dodo which appeared in 1917: "Dodo-Studien, naar aanl eiding van de vondst van een gevelsteen, met Dodo-beeld van 1561 te Vere" (*Verh. kon. Akad. v. Wetensch.*, 2e Sect., 19, No. 4).

It sometimes happens when a man's life-work is mainly devoted to a relatively obscure subject that he becomes better known by work done on matters of more popular interest. It was so to a certain extent with A. C. Oudemans; he was widely known as the writer of works on the 'sea-serpent' and the dodo, but not always identified with the magnificent work he did on the Acari, in which field he was supreme. In recent years, however, his fame as 'father of acarology'—as he has been called—has spread more widely, partly through the increasingly obvious importance of the study of acarology both from the economic and medical points of view.

His magnum opus is the "Kritisch Historisch Overzicht der Acarologie". This is an encyclopædia of all recorded observations on the Acari from 850 B.C. until A.D. 1850 compiled with painstaking completeness. This vast work of reference is arranged in three parts. The first part appeared in 1926 as a supplement to vol. 69 of the *Tijdscrift voor Entomologie 's-Gravenhage* and deals with the period 850 B.C. to A.D. 1758 (500 pages with 68 text-figures, among them being reproductions of some very interesting contemporary drawings). Part 2, dealing with the years 1759–1804, was also published as a supplement to a volume (vol. 72, 1929) of the *Tijdscrift* (1097 pages with 267 text-figures). Part 3, dealing with the years 1805–50, was published as a separate work by E. J. Brill (Leyden). This part was divided into six volumes, *A–G*. Volume *A*, 1936 (430 pages with 179 text-figures), contains all general references during the specified time to Acari generally and Holothyroidie and Mesostigmata in particular. Dr. Max Sellnick collaborated with Dr. Oudemans in the section dealing with the Mesostigmata. Volume *B*, also published in 1936 (367 pages with 170 text-figures), is devoted to Ixodides, with Dr. Paul Schulze collaborating. Volume *C* (550 pages, with 230 text-figures), published, as were all the subsequent volumes, in 1937, deals with the Tarsonemini, Stomostigmata and Eleutherengona (including Halacaridæ and Tetrapodili); Dr. Oudemans acknowledged help from Dr. Karl Viets in the work done on the Halacaridæ. Volume *D* (649 pages, with 332 text-figures) is devoted to Parasitengona; volumes *E* and *F*, issued together, contain in *E* all references to the Acaridæ (522 pages with 159 text-figures) and in *F*, with the help of Carl Willmann, all the references to the Oribatei (215 pages, with 147 text-figures). Volume *G* (643 pages) is an index to Part 3. In all, the work runs to more than five thousand pages and some fifteen hundred illustrations. The arrangement of each part is under the headings of systematics, external morphology, internal anatomy, histology, physiology, teratology, ecology, embryology, ontogeny, phylogeny, habitat, chronology, distribution, economics, medical zoology, nomenclature and literature. It is thus obvious that all the aspects of the subject came under Dr. Oudemans' notice and were documented in such a manner as to make this "Kritisch Historisch Overzicht der Acarologie" a work of outstanding importance to the acarologist.

In addition to his publications, one of the great services Dr. Oudemans rendered was his interest in and enthusiastic encouragement of younger acarologists throughout the world. In this his natural gift as a teacher was clearly discernible. He was always ready to answer questions promptly and fully, and where it was possible for anyone working on his subject to visit him in Arnhem, his kindness and simplicity made them instantly at home. There he placed at their disposal not only his collection of 7,500 microscopical preparations and his library of more than 10,000 works on Acari and the 65,000 drawings made by him in the course of his own work, but also he gave freely of his most valuable time.

The collections and drawings made by Dr. Oudemans are now safely housed in the Rijksmuseum voor Natuurlijke Historie, Leyden, and will be of the greatest value in the future of the subject that Dr. Oudemans served so faithfully.

SUSAN FINNEGAN.

Major S. S. Flower, O.B.E.

MAJOR STANLEY SMYTH FLOWER, who died at Tring on February 3, was a born naturalist, who from his boyhood took a keen interest in all living beings, and will be remembered especially for his important series of papers on the duration of life in various animals.

Flower was born in the Conservator's House at the Museum of the Royal College of Surgeons, Lincoln's Inn Fields, on August 1, 1871. He was the second son of Sir William Flower, and as a boy often accompanied his father to meetings of the Zoological Society, and met most of the famous naturalists of his time. He was educated at Wellington and King's College, London, entered the army in 1890 and was commissioned into the Northumberland Fusiliers. He was seconded to the Siamese Government as scientific advisor in 1896 and spent two years in Bangkok, also travelling in Siam and Malaya.

In 1898 he became director of the Giza Zoological Gardens and occupied this post until his retirement in 1924. He made several journeys to the Upper Nile and was responsible for drafting the laws of the Game Preservation Department of the Sudan Government. He also took an active part in the protection of fauna, and thanks mainly to his efforts egrets are now once again common in Egypt. By 1912 plumage hunters had reduced them to only two small colonies, but after protective legislation had been introduced they soon multiplied, and I remember the pride it always gave Flower to see these beautiful birds coming in their hundreds at sundown to roost in the trees in the Giza Zoological Gardens.

Flower served during the First World War as commander of the Camel Transport Corps and later in the Frontier Districts Administration; he was awarded the O.B.E., the Order of the Nile, and of the Medjidieh, and mentioned in dispatches.

After his retirement, he took an active interest in the Zoological Society of London, and served on its Council during 1924–36, and was vice-president during 1927–29. He was also chairman of the British Ornithologist's Club (1930–32), and an honorary member of various foreign societies.

Flower's many zoological publications include "The Mammalia of Siam and the Malay Peninsula" (1900); a series of reports on the Giza Zoological Gardens, containing much useful information; mammals and reptiles in "The List of Vertebrated Animals exhibited in the Gardens of the Zoological Society of London" (1927); and his papers on the duration of life in animals (1925 *et seq.*), many of them based on personal observations and breeding experiments which he continued to the end of his life. A note on the duration of life in woodlice, by W. E. Collinge, based on Flower's observations, appeared in *Nature* as recently as December 22, 1945 (p. 755). EDWARD HINDLE.

Prof. Heinrich Rausch v. Traubenberg

IT is more than a year ago since I heard of the tragic death of my friend Traubenberg; but only now have I got authentic news about his fate.

Traubenberg was born on March 17, 1880, in Estonia, a descendant of one of the ancient families who ruled those provinces for centuries. These 'Baltic Barons' combined great activity in administration and politics under the Czars with an extremely high level of culture in their private lives. Traubenberg, though free from worldly ambitions, was deeply imbued with that cultural inheritance of his ancestors. He studied at the Universities of Leipzig, Freiburg and Würzburg, where he graduated under W. Wien in 1905 with a thesis on the Hall effect.

In the following years he worked in the laboratories of different electrical engineering firms in Berlin, but returned soon to scientific research in Leipzig, Würzburg and St. Petersburg. In 1910 he went to Göttingen, where I first met him. He was gentle and kind, quiet and modest, a hard worker and keen thinker. As soon as he discovered that I shared his enthusiasm for physics we became friends. In him there burned a genuine fire for all that was great and noble. He loved discussions on philosophy, art, science, religion, and was a splendid opponent in an argument, full of wit and humour. I shall never forget those evenings of friendly controversy backed by a bottle of good Burgundy.

In 1912 Traubenberg became a lecturer (*Privat-Dozent*) at Göttingen. After the death of Prof. E. Riecke, in 1915, he was deputy director of the laboratory for several years. In 1922 he was called to a chair at the German University in Prague, and in 1931 he succeeded Geiger in Kiel.

Traubenberg's work covers a wide field. During his stay in Göttingen, he determined the ranges of α-particles in liquids and solids, a work much appreciated by Rutherford. Among many papers of his on radioactivity I may mention his measurement of the solubility of radium emanation in water, by which it was shown that Henry's law is valid for these extremely minute amounts of rare gases. Later his interest was concentrated on positive rays. He investigated the Stark effect in rapidly changing and in extremely strong electric fields. Shortly after Rutherford's discovery of the artificial disintegration of nuclei, Traubenberg showed that the lithium nucleus could be split by protons of as little energy as 30,000 eV., and he investigated the penetrating radiation accompanying this process. His last papers, written in extremely difficult circumstances, are mostly concerned with neutrons.

Traubenberg had never yielded to the Nazi creed of race-and militarism, and therefore lost his chair at the University of Kiel in 1937. His attempts to leave Germany were not successful. After having overcome a bad nervous breakdown he took up work in an industrial laboratory in Berlin, but returned later to pure research in a little private laboratory, with no other help than that of his wife, on problems of nuclear physics. In 1944 his house was burned down in an air-raid. The Traubenbergs found refuge in Hirschberg, Bohemia, on the estate of Count Karl Waldstein. He was beginning to work again on his beloved experiments when his wife was arrested by the S.S. He collapsed and died a few hours later, on September 19, 1944. MAX BORN.

Dr. L. Kuščer

MR. R. S. HAWES, University College, Exeter, has learned from Dr. Jovan Hadži, professor of zoology in the University of Ljubljana, that Dr. L. Kuščer, the well-known malacologist, died in 1943, after imprisonment by the Italians. Dr. Kuščer was an authority on the cavicolous snails of Jugoslavia, and, in spite of difficulties which would have defeated a lesser enthusiast—he lived in constant ill-health and in something near to poverty—he had assembled an unrivalled collection of his material. He was an incorrigible idealist and admirer of Britain. British zoologists whose work took them to Slovenia will remember his cheerful, untiring helpfulness and simple, but charming, hospitality.

We regret to announce the following deaths:

Mr. R. Engelbach, technical adviser to the Antiquities Department, Egyptian Government, since 1942, and author with the late Mr. Somers Clarke of "Ancient Egyptian Masonry", on February 26, aged fifty-seven.

Dr. F. W. Lanchester, F.R.S., consulting engineer, on March 8, aged seventy-seven.

Dr. Max Poser, special technical representative of the Bausch and Lomb Optical Co., who contributed to the design of many eye examination instruments, such as the Ives visual acuity apparatus, the stereo campimeter and the Poser slit lamp, on January 4, aged seventy-five.

NEWS and VIEWS

Research in Great Britain on Atomic Energy

CAPTAIN A. R. BLACKBURN asked in the House of Commons on March 5 whether fundamental research on atomic energy in the universities of Britain has been delayed by lack of equipment. In reply, the Prime Minister said that the Government is kept in touch with the needs of universities for surplus stores by the University Grants Committee. In addition, the Advisory Committee on Atomic Energy has recently set up a sub-committee, on which the universities working in this field are represented, to review the programme of nuclear physics research to be carried out in Great Britain as a whole. No representations have been made to that sub-committee regarding any delay due to lack of surplus Government material. The intention of the Government, he said, is that the needs of such research should be accorded the highest priority. Dealing with a further question, the Prime Minister said that the programme of atomic research in Great Britain is not limited by financial considerations but by the numbers of trained men of science and the material resources available, especially in building and engineering equipment. Expenditure on the programme for the year 1946–47 is estimated at approximately £2,800,000.

United Nations Educational, Scientific and Cultural Organisation

THE American Association of Scientific Workers has issued a manifesto asking for full and immediate support of the United Nations Educational, Scientific and Cultural Organisation. It is urged that the science division in the Organisation should concern itself with all phases of scientific international collaboration, and to indicate the potentialities for such a division, a nine-point programme suggesting some of its possible functions has been prepared. In brief, this programme asks that the United Nations Educational, Scientific and Cultural Organisation should (1) promote the exchange of scientific workers on a world-wide basis; (2) have the responsibility of facilitating the prompt interchange of scientific information; (3) take the lead in the reorganisation of scientific abstracting; (4) facilitate the prompt revival of the pre-war international scientific unions and assist in the formation of new unions; (5) aid in the rehabilitation of scientific institutions in areas devastated by the War; (6) give aid and advice to the growing scientific institutions in countries like China, India and some of the Latin-American Republics; (7) undertake comprehensive surveys of the scientific and technological potentialities and resources of under-developed regions and issue full public reports; (8) co-ordinate its activities with those of other international organisations with scientific and technological functions; (9) become the principal scientific advisory body in the United Nations Organisation.

The memorandum goes on to point out that no international organisation can have strength without the support of individuals and organisations which it affects, so that if the United Nations Educational, Scientific and Cultural Organisation is to become a powerful organ for world-wide scientific collaboration, it must have the active support of the public, of political leaders and of the scientific workers of all nations. The Association therefore urges men of science of the United States to interest themselves both individually and corporately in the new Organisation, and to act promptly in these matters. Finally, the American Association of Scientific Workers asks scientific colleagues in the Soviet Union, which was not represented at the recent Conference, to join in this important international co-operative development. "The artificial and wholly unnecessary barriers which have too long prevented a thorough scientific collaboration between the Soviet Scientists and those of the Western nations must now be removed. This can be achieved most effectively by united action to make UNESCO a powerful organisation for the promotion of international collaboration in the sciences and for world peace."

Exhibition of German Electronic Equipment

SOON after the end of the War in Europe, investigation parties were organised and dispatched to Germany and the occupied countries for the purpose of studying in detail the advances made by the Germans in recent years in scientific research and technical development and application. These parties comprised in the first place operational military personnel, followed by experienced staff from research establishments in Britain; and more recently, opportunities have been provided for representatives of British industry to make visits and tours of inspection. In many cases samples of equipment and components indicative of advanced lines of development have been brought back to Great Britain for more extended study, experiment and use.

An exhibition of such items as fall within the scope of electronic equipment has been organised by the Ministry of Aircraft Production, and was available recently at Earl's Court Exhibition to those who were technically interested. The exhibition, which was arranged in an admirably systematic and clearly illustrated manner, comprised sections dealing with communications and radar equipment; radio navigational aids; acoustic and infra-red research and applications; and with selected components, measuring instruments and test gear for use in these fields of work. An interesting section dealing with telemechanics illustrated the magnitude of the research programme in Germany on guided missiles, of which some forty-eight different types were at one time under development, and most of which incorporated electronic control equipment of a special and very elaborate type. The Germans devoted a great deal of effort and man-power to infra-red research, and while the return they obtained from it in effective military advantages appears to have been small, samples were displayed at the exhibition of some of their equipment, ranging from a 'black' searchlight for use on tanks to a portable light and electronic telescope for snipers to work under cover of darkness.

While a certain amount of measuring instruments and test equipment were displayed at the exhibition, many of these have not yet been studied in detail. It is also felt that the work done at some of the German research establishments must have necessitated other measuring equipment and techniques than those so far reported; and a team of scientific workers is now in Germany studying this matter. The body responsible for standardization was the Physikalische Technische Reichsanstalt, of which

the electrical section was evacuated from Berlin to Thuringia. Considerable work was done on crystal clocks of high precision, and standard frequencies were distributed both by telephone line and by radio transmission. Towards the end of the War, the Reichsanstalt did some work on centimetre and millimetre wave-lengths, including the frequency comparison of cavity and line wave-meters. Altogether, the exhibition has served a very useful purpose, in bringing to the notice of scientific and technical workers in Great Britain an appreciation of the state of German research and development in the field of electronics during the war years.

Education in the British Army : Major-General Cyril Lloyd, C.B.E.

RECENT changes at the War Office have led to speculation about the future of Army education. The former director-general, Mr. P. R. Morris, has taken up his post as vice-chancellor of the University of Bristol, while Mr. W. E. Williams, the former director of the Army Bureau of Current Affairs, has been appointed director of a corresponding civilian organisation, the Bureau of Current Affairs, which has been set up by the Carnegie United Kingdom Trust. The position at the War Office has now been clarified by the announcement that Major-General Cyril Lloyd—to whom we offer congratulations on his promotion—has been appointed director of Army education. The directorate of Army education and the Bureau of Current Affairs have now been merged into one directorate over which General Lloyd will preside.

General Lloyd is a graduate of University College, London, where he took a first-class honours degree in physics and mathematics. After a period of post-graduate research at Cambridge, he was appointed senior science master at Brighton Grammar School. His record during the War has been particularly distinguished and led to his appointment as Deputy-Adjutant-General with 21st Army Group under Field-Marshal Montgomery. For his services in the Normandy campaign he was invested with the C.B.E. while in Holland. In December 1944 he was recalled to Great Britain and appointed director of Army education at the War Office. Men of science will be pleased to hear of his recent promotion and will be glad to know that the War Office have entrusted the future of Army education to a young officer who, by his record as a soldier and as an educationist, has shown his capacity to shoulder heavy responsibilities with courage and resolution. Both qualities will be needed in General Lloyd's new post.

British Institution of Radio Engineers : Lord Louis Mountbatten

LORD LOUIS MOUNTBATTEN has been elected president of the British Institution of Radio Engineers for 1946–47. Admiral Mountbatten has specialized in radio since 1925. He served as senior wireless instructor at H.M. Signal School (1929–31), and was responsible for the writing of the first Admiralty Handbook on Wireless Telegraphy sets, and also supervised a new edition of the Admiralty Handbook on Wireless Telegraphy. To encourage the training and education of radio engineers, Admiral Mountbatten established in 1939 a "Mountbatten Medal", to be presented to the most outstanding candidate of the three Services successful in the graduateship examination of the British Institution of Radio Engineers.

International Meteorological Organisation

THE International Meteorological Organisation met in London during the week beginning February 25 for its first post-war conference. Some eighty delegates, consisting of the directors and members of the meteorological services of forty-six nations, were in private session under the chairmanship of Dr. Th. Hesselberg, president of the International Meteorological Committee since 1935. Dr. Hesselberg is the director of the Norwegian Meteorological Service. The first task of the conference was to re-form its various committees and technical commissions, and to fill the numerous vacancies in these bodies which had occurred since the last meeting of the Organisation in Berlin in May 1939. Six regional commissions were also formed, partitioning the whole world; each commission covers broadly a continent and its adjacent ocean areas. The new machinery thus set up has been given instructions and guidance for adapting to peace-time purposes the many developments in procedure and technique which have been evolved during the war years. The primary object in view has been to meet the requirements of long-distance flights by civil aircraft, and to see that the full resources of modern meteorological science are made available as quickly and effectively as possible to ensure the safety and regularity of air-lines operating on the international routes. Next year, the International Meteorological Organisation plans to hold meetings of all its commissions in Toronto, to be followed by a conference of directors and a meeting of the International Meteorological Conference in Washington. At the close of the London conference, Dr. Hesselberg retired from the presidency of the Organisation, and Sir Nelson Johnson, director of the Meteorological Office, London, was elected as his successor.

British Association Meeting for 1946

THE British Association has found it impossible to arrange this year an annual meeting on the lines of the pre-war meetings in provincial cities. A one-day meeting will therefore be held on July 20 in London. The British Medical Association has generously granted the use of its hall for this occasion. The presidential address will be delivered by Sir Richard Gregory. There will be no sectional meetings. Opportunity will be taken to receive delegates attending the Empire Scientific Conference organised by the Royal Society, and the Commonwealth Scientific Official Conference, at a luncheon on July 20 and at the subsequent meeting, and also, it is hoped, at a Sunday afternoon reception at Down House, the home of Charles Darwin. It is also hoped to receive some of the foreign delegates who are expected to be in England at that time. It is intended to resume normal meetings in subsequent years, and an invitation has been accepted for the meeting in 1947 to be held in Dundee, where the meeting in 1939 was cut short by the imminence of war. An invitation from Brighton for 1948 has also been accepted.

Water Supply and Food in India

IN a pamphlet entitled "Food and Irrigation Problems affecting India in General and Bombay in Particular", Rao Bahadur N. S. Joshi discusses ways of meeting the estimated requirements of 1971. He is concerned mainly with the engineering aspects of the irrigation presumed to be needed; and though the nutritional discussion is mainly in terms of crop

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HANDBOOK OF METEOROLOGY

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1068 pages **9 × 6** **Illustrated** **45s.**

The most complete work of its kind ever published, this handbook constitutes an invaluable text and reference book covering the entire subject of meteorology, and presenting a wealth of authoritative information needed by both the beginner and the expert in the field.

Every section is profusely illustrated with selected photographs, maps, sketches, and line drawings, and contains much information hitherto unavailable. Every technique is fully described by example, and all practical forecasting rules and methods are illustrated by examples selected from nature.

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CIVIL SERVICE COMMISSION

Applications are invited for competitions by interview to fill vacancies on the scientific staffs of Government Departments.

(a) Scientific Officers and Senior Scientific Officers (age 21–30), 300–500 vacancies; candidates must possess a university degree in a scientific subject or in Mathematics with first or second class honours or an equivalent qualification.

(b) Assistant Experimental Officers and Experimental Officers (age 18½–30), 750–1,000 vacancies; candidates must possess a university degree in a scientific subject or in Mathematics, or a Higher School Certificate with Mathematics or a scientific subject as a principal subject, or an equivalent qualification.

Salary of Scientific Officers £275–£500 (men) or £275–£430 (women), and of Assistant Experimental Officers £150–£350 (men) or £150–£280 (women); war bonus is no longer paid but instead there is a consolidation addition which at the minimum of the scales amounts to £78 at age 21 and over.

Full particulars are contained in the detailed Regulations, which, together with the appropriate Application Form, can be obtained from the Secretary, Civil Service Commission, Burlington Gardens, London, W.1, or from the Chief Officer, Civil Service Commission, at the following addresses:

(India) 10 Underhill Lane, Delhi.
(Egypt) 9 Sharia El Birgas, Cairo.
(Italy) c/o Headquarters, 3rd District, C.M.F.
(Germany) c/o 2nd Echelon, G.H.Q., B.A.O.R.

Candidates now serving in H.M. Forces or the Women's Services must send in their application forms in time to reach the Civil Service Commission not later than six months after the completion of their service. All other candidates must send them in by May 1, 1946.

UNIVERSITY OF BIRMINGHAM

FACULTY OF SCIENCE

Applications are invited for Lectureships in the Department of Industrial Metallurgy. Two appointments may be made, one for foundry metallurgy, and one for the metallurgy of wrought fabrication. The Lecturers will enjoy ample opportunities for research. Candidates must possess a good University degree, preferably (though not essentially) in metallurgy, and have had adequate experience of production, either in the melting and casting of metals or in the fabrication (rolling, forging, extrusion, etc.) of wrought metals. Appointments in the first instance will be for a period of not more than five years. Salary up to £600 per annum, depending on experience and qualifications.

Further particulars may be obtained from the undersigned, to whom applications should be sent not later than March 25, 1946.

C. G. BURTON,
Secretary.

The University,
Edmund Street, Birmingham, 3.

UNIVERSITY OF LIVERPOOL

Applications are invited for the following two posts in the Department of Botany:—

(i) Ungraded Lecturer in Botany. Salary £350 per annum.

(ii) Part-time Demonstrator in Botany. Salary not exceeding £200 per annum.

The appointment for each post will be for one year in the first instance, and will be renewable. The University will consider applications from candidates in the Forces or engaged on National Service.

Applications, stating age, academic qualifications and practical experience, together with the names of three referees, should be received not later than June 1, 1946, by the undersigned, from whom further particulars regarding the Ungraded Lectureship may be obtained.

STANLEY DUMBELL,
Registrar.

SHEFFIELD NATIONAL CENTRE FOR RADIOTHERAPY

(Formerly the
SHEFFIELD RADIUM CENTRE)

Applications are invited for the post of Grade 1 ASSISTANT TECHNICIAN. Candidates must be qualified in instrument making and preference would be given to one who has had experience in an experimental workshop laboratory. Scale of pay £300–25–£350, the initial salary being according to qualifications and experience. F.S.S.U. in force. Applications should reach the Centre not later than Monday, May 6, 1946, and be addressed to the Secretary, "Broom Cross", Tree Root Walk, Sheffield, 10.

Box 479. Head of Research Department. Candidates are thanked for their letters. Appointments for interview have been made with selected applicants.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE

(UNIVERSITY OF LONDON)

INCORPORATING THE ROSS INSTITUTE

DIPLOMA IN BACTERIOLOGY

The next course for the Academic Diploma in Bacteriology will be held from October 1946 to June 1947. Admission is restricted to graduates in Medicine, Science and Pharmacy, and to certain other students whose qualifications and training have fitted them to profit by the course.

Applications should reach the Registrar, London School of Hygiene and Tropical Medicine, Keppel Street (Gower Street), London, W.C.1, as soon as possible. Candidates will be informed in April or May whether or not they have been selected.

THE UNIVERSITY OF SHEFFIELD

Applications are invited for the post of ASSISTANT LECTURER in GEOGRAPHY. Salary £350 per annum in the first year, with Superannuation provision under the Federated Superannuation Scheme for Universities, and War-time marriage and children allowance. The successful candidate will be required to enter upon his duties on April 24, 1946, or as soon thereafter as may be practicable. Applications (three copies) including the names and addresses of three referees, and, if possible, copies of two testimonials, should reach the undersigned (from whom further particulars may be obtained) not later than April 5, 1946.

A. W. CHAPMAN,
Registrar.

UNIVERSITY OF BRISTOL

ELECTRICAL LABORATORY MECHANIC WANTED

Applicants should be versatile craftsmen, preferably trained as Instrument or Tool Makers, and/or accustomed to working with experimental mechanisms. Experience on non-ferrous metals, and/or the use of varied light machine tools, is desirable. Salary based on Trade Union rates, with an extra allowance for exceptional qualifications. The vacancy would be reserved if the selected applicant were not immediately available.

Applications, giving a detailed record of the candidate's experience, should be received by the undersigned by March 23.

WINIFRED SHAPLAND,
Secretary and Registrar.

UNIVERSITY OF ABERDEEN

LECTURESHIP IN POLITICAL SCIENCE

The University Court will shortly proceed to the appointment of a Lecturer in the Department of Political Science.

Salary £400–£650, according to qualifications and experience.

Persons desirous of being considered for the office are requested to lodge their names with the Secretary to the University on or before June 29, 1946.

Conditions of Appointment and Form of Application may be obtained from the undersigned.

H. J. BUTCHART,
Secretary.

The University,
Aberdeen.

UNIVERSITY COLLEGE NOTTINGHAM

ASSISTANT LECTURER IN PHARMACOGNOSY

The Council invites applications for the appointment of Assistant Lecturer in Pharmacognosy at a commencing salary of £350 per annum. Candidates should be graduates in Chemistry, Botany or Pharmacy and should be registered pharmacists. Further information and forms of application, which should be returned not later than Saturday, March 30, may be obtained from the Registrar.

NATIONAL INSTITUTE FOR RESEARCH IN DAIRYING

(UNIVERSITY OF READING)

ROLE OF THE INTESTINAL FLORA IN NUTRITION

The following research appointments are to be made forthwith: (1) A bacteriologist to work on the intestinal flora; (2) a biochemist, preferably but not necessarily with bacteriological knowledge, for microbiological assay of the vitamins. Particulars from the Secretary, N.I.R.D., Shinfield, nr. Reading.

UNIVERSITY OF READING

Applications are invited for the post of Assistant Veterinary Investigation Officer. Salary £400, plus £90 bonus. The successful applicant will be eligible for consideration for superannuation benefits under the Federated Superannuation System for Universities. Further particulars may be obtained from the Registrar.

UNIVERSITY OF GLASGOW

DEPARTMENT OF CHEMISTRY

Applications are invited for two posts in the Department of Chemistry. (a) LECTURER (Grade IIb or III) in organic chemistry (salary range, £400 to £580—initial salary according to qualifications and experience); (b) LECTURER (Grade III) (salary £400 to £480) or ASSISTANT (salary £300 to £380), to assist with practical class for medical students and to participate in research on the use of isotopes in chemistry.

Applications (3 copies) are required by March 30.

ROBT. T. HUTCHESON,
Secretary of University Court.

BEDFORD COLLEGE FOR WOMEN

(UNIVERSITY OF LONDON)

REGENT'S PARK, N.W.1.

NINA BOYLE MEMORIAL PRIZE, £10, for the best essay on a subject connected with the position and work of women; open to all present students of Bedford College and past students of not more than three years standing.

LADY HUGGINS SCHOLARSHIP, £130, for study or research in Sociology; open to women holding a University degree or its equivalent. For further particulars apply the Secretary.

Applications are invited from Chemists for a post in India. The successful candidate will act as personal assistant to the Head Chemist. Duties include research and experimental work and opportunities to become familiar with the manufacture of Sugar. Qualifications required B.Sc. or A.I.C., but experience not necessary. Salary at the rate of Rs. 800–850–900 (rupee = 1s. 6d.) per month to commence at date of leaving England. Free passage out and home including third class railway expenses in England and first class in India. Free quarters assessed for income tax payable by employee. Dearness allowance at present 17.5 per cent on salary. Bonus according to circumstances, at present 1 month's salary. Applicant will be required to become member of Provident Fund and must submit to medical examination, vaccination and anti-typhoid inoculation before appointment.

Write quoting F.64A to Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 572, York House, Kingsway, London, W.C.2, for application form which must be returned completed by March 30, 1946.

The British Electrical and Allied Industries Research Association invite applications for two appointments as follows:—

(1) Head of Department comprising investigations which relate to design, operation and security aspects of electrical installations, in particular cable and overhead line transmission, distribution, communication interference, earthing corrosion.

(2) Head of Department comprising investigations which relate to the properties, structure and application of materials, especially Dielectrics, in Electrical Engineering.

The duties will be carried out mainly at the Association's Laboratories at Perivale, Middlesex, but a move to Leatherhead is anticipated. The minimum starting salary is £950 per annum exclusive of cost of living bonus, National Whitley Scale. Superannuation (F.S.S.U.) is applicable. Applications, which should be received by the Director, E.R.A., 11 Savoy Street, W.C.2, not later than March 31, 1946, need not include testimonials but should include names of referees and list of references to published work. Successful candidates would be expected to begin their duties not later than October 1, 1946.

Wanted for Telecommunications Research Laboratory in London:

WOMAN LIBRARIAN for Technical Library. Experience essential. Ex-Service woman with cypher and/or Radar knowledge would be considered.

Two ABSTRACTORS (male) with ability to prepare precis for technical publications. Languages preferred.

TECHNICAL WRITER, male, with knowledge and experience of technical publicity. Good education essential.

WOMAN GRADUATE, for design of electrical filters, networks, etc.

Applicants should write, giving full details of qualifications and salary required, to Box J5528, A. K. Advg., 212a Shaftesbury Avenue, W.C.2.

A graduate in Physics or Electrical Engineering is required to take charge of a research technical library, with extracting, indexing, etc. Ability to translate from French and German would be a useful asset, but actual library experience and training not essential. Salary according to qualifications and experience. Write stating age, qualifications and experience to Box 549, T. G. Scott & Son, Ltd., 9, Arundel Street, London, W.C.2.

The Government of Iraq require the undermentioned personnel in connection with plans for agricultural development. Appointment is for three years in the first instance. Provident Fund. Free first-class passages.

EXPERT IN ENTOMOLOGY. Salary I.D. 150 a month plus high cost of living allowance I.D. 24 a month. Candidates must be Ph.D. and have a liberal knowledge of general entomology with wide practical experience in economic insect problems particularly biological control, and previous service in a sub-tropical country.

ENTOMOLOGIST. Salary I.D. 100 a month plus high cost of living allowance I.D. 24 a month (I.D. 1 = £1). Candidates must be Ph.D. and should be capable of undertaking the study and identification of insects in Northern Iraq and of advising regarding means of combating them.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience to the Crown Agents for the Colonies, 4, Millbank, London, S.W.1, quoting M/N/12711.

Applications are invited for the follow-ing posts in the Geological Research Centre in London of a major Oil Company :—

(1) SENIOR PALÆONTOLOGIST with all-round experience and some practical knowledge of Micropal ontology; Reference No. G.48.

(2) MICROPALÆONTOLOGIST specializing in the Foraminifera; Reference No. G.47.

(3) MICROPALÆONTOLOGIST specializing in the Ostracoda. Reference No. G.46.

Salaries according to qualifications. Salary range £900–£1,200 p.a.

Write quoting appropriate reference number to Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 572, York House, Kingsway, London, W.C.2, for application form which must be returned completed by March 30, 1946.

The Council of Somerville College, Oxford, offers a LADY CARLISLE RESEARCH FELLOWSHIP open to unmarried women and widows of British nationality for research in Classics, Classical Archæology, Philosophy, History, Economics, Natural Science or Mathematics. The appointment will be for five years in the first instance from October, 1946. Annual value, £250, with board and residence for at least four years. Further particulars obtainable from the Secretary, Somerville College, Oxford, to whom application must be made by April 1, 1946.

The Council of Somerville College, Oxford, offers a MARY SOMERVILLE RESEARCH FELLOWSHIP, annual value £325, for three years from October, 1946, with board and residence for a maximum of three terms. Particulars of the Fellowship, which is open to Oxford women only, may be obtained from the Secretary, Somerville College, Oxford. Final date for applications, April 1, 1946.

Required immediately, Instrument Engineer, aged 25–35, of University or Technical College to Degree or Diploma standard, alternatively Secondary School and full engineering apprenticeship. Candidates should have two or three years in manufacturing, testing or servicing departments of a reputable firm of Industrial Instrument Manufacturers or in Instrument Dept. of large user of industrial instruments. Salary according to qualifications and experience. Write giving full particulars and when available to Box 543, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Released personnel from H.M. Forces. Vacancies overseas exist in leading British oil company operating in Middle East for University Graduates in Engineering (both Mechanical and Civil), Chemistry, Physics and Geology. Age up to 30 years; able to pass strict medical examination. Commencing salary according to qualifications, but not less than £540 per annum plus allowances in local currency; also Provident Fund benefits. Kit allowance, free passages, free furnished bachelor accommodation and free medical attention. Married accommodation not available for first 3 years. Apply giving full particulars to Box 532, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Mathematician with specialized know-ledge of Aerodynamics and some engineering experience required for assisting in compressor and turbine design in research organisation of large company. Salary according to qualifications and experience. Also junior post for young graduate with similar qualifications and previous industrial experience. Box 538, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

University of London, King's College, will require in October next the services of a Lecturer and an Assistant Lecturer in Physics. Applications will be received and considered in the month of June. Particulars and forms of application from the Secretary, King's College, Strand, W.C.2.

Aero-Engine Research Laboratory has vacancy for experienced Assistant to Director of Research. University degree with research experience on Piston and/or Turbine Engines necessary. Salary approximately £1,000, depending on qualifications. Write giving full particulars and when available to Box 544, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Assistant to Chief Engineer required for large Chemical works in East London. Chemical and Electrical Plant experience essential. Age about 35 years, B.Sc. Engineering degree. Ex-serviceman, due for demobilization, considered. Good salary and excellent prospects. Box 545, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Laboratory Assistants. Two assistants of Inter. B.Sc. standard (matriculation essential) with 2 to 7 years' experience in an industrial laboratory. One for routine analytical control of fine organic chemicals (vitamins, etc.) and the other for investigation of work of a preparatory nature, 5 day week, facilities given for studies. Salary according to experience. Apply Box 546, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Graduate (preferably communication or electrical engineering) wanted for research and development work, with experience in the design and testing of audio-frequency equipment, particularly microphone. Write stating age, fullest details of academic qualifications, experience, together with salary required, to Box 547, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Electronic Laboratory Engineer and Research Worker required for experimental and development work on H.F. heating equipment and application of dielectric heating to particular industrial problems. Degree in Physics and Electrical Engineering essential. Box 548, T. G. Scott & Son, Ltd., 9, Arundel Street, London, W.C.2.

Computer required for the Research Laboratories of a large Engineering firm, West of London. Previous experience in computing is desirable although not essential but applicants should be of Higher School Certificate in Mathematics. Salary according to qualifications and experience. Write stating age, qualifications and experience to Box 542, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Chemists required for Research Depart-ment of progressive firm in Manchester area. Physical chemical experience preferred but not essential. Salary according to qualifications and experience. Apply Box 541, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Optical Designer and Lens Computer required by precision optical and mechanical instrument firm in the West Country. The position offers excellent prospects. Salary according to qualifications and experience. Write Box 540, T. G Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Electrical Engineer or Physicist with knowledge of editorial and press work required as Assistant Editor of the Journal of the Institution. Mathematics and foreign languages an advantage. Applications, by letter only, to the Secretary, The Institution of Electrical Engineers, Savoy Place, W.C.2.

Manager required to undertake general management and control of production, warehouse and office sales staff of Laboratory Chemicals Group of The British Drug Houses Limited, London. Appointment will involve full responsibility for results in terms of turnover and profits. Write, stating age, experience, and salary required.

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area and tonnages, the need for improved diet is not neglected. On account of the great distances, a general transfer of food from 'surplus' to 'deficit' provinces is impracticable. The solution is, in the author's view, a great increase in irrigation; but in Bombay it is not possible to extend greatly the kind of barrage-and-canal irrigation that has been a spectacular success in the river-plains regions. The pamphlet may be regarded as a reasoned critique of canal irrigation. Contour cultivation (bunding) may increase yields in hilly areas, but the crops suitable for upland cultivation are grains of low nutritional value, of which Bombay normally has a surplus; and contouring is incompatible with storage from catchments. The ultimate solution for Bombay Province, therefore, is a very great increase in the number of small wells. The author suggests how these might be planned and financed, and in addition he shows how barrage and water-storage schemes could be provided so as to make the greatest possible use of all water resources. The pamphlet is stimulating, and has much value as a source of information regarding the current status and economics of irrigation and food-production in various provinces of India. The reader is left with the feeling that the main difficulty is social rather than engineering.

Horticultural Uses of D.D.T.

A USEFUL short paper by G. Fox Wilson (*J. Roy. Hort. Soc.*, **71**, Pt. 1, January 1946) gives some timely results with the use of D.D.T. for controlling various garden pests. This substance has no egg-killing properties, is useless against red spider and other acarine mites, and has no useful action against aphids. Spectacular control of numerous pests is reported, however, notably of the apple blossom weevil and of the greenhouse thrips (*Heliothrips hæmorrhoidalis*). The unselective action of D.D.T. can be a danger, for ladybirds and other predators are killed along with the pests. Use of the substance as a larvicide in garden ponds may be a very mixed blessing for other and more desirable members of the fauna. Hive bees and other pollinating insects are destroyed by untimely applications. It is very obvious that D.D.T. must be used with care, and under expert advice, until its wide implications are thoroughly investigated.

Arsenic in Tobacco Smoke

THE presence of arsenic in the smoke of some kinds of tobacco is the subject of an annotation in the *British Medical Journal* (94, Jan. 19, 1946). Remington (*J. Amer. Chem. Soc.*, 49, 1410; 1927) found that about half the arsenic present is volatilized when tobacco is smoked, and Gross and Nelson (*Amer. J. Pub. Health*, 24, 36; 1934) showed that 15–40 per cent of it goes into the smoke. Thomas and Collier (*J. Induet. Hyg.*, 27, 201; 1945) found wide variations in the arsenic content of different brands of tobacco. In the puffed smoke of the cigars used for their experiments they found 0·2–3·0 mgm. of arsenious oxide, in that of the pipe tobacco examined 1·7–5·7 mgm., and in that of the cigarettes 3·3–10·5 mgm. The cigars themselves, however, contained less arsenic than the pipe tobacco or cigarettes. H.M. Chief Inspector of Factories, continues the annotation, in his annual report for 1943 (Cmd. 6563, H.M. Stationery Office, 1944) recorded three cases of carcinoma of the lung since 1939 in arsenical sheep-dip workers and referred to the high incidence of this disease in arsenic workers, a problem which is being studied by the Medical Research Council. There appears to be strong evidence that arsenic dust predisposes to carcinoma of the respiratory tract. The carcinogenic properties of the arsenic in tobacco smoke and the enormous increase in the use of tobacco justify, it is stated, a full investigation of this subject.

Centenary of F. W. Bessel (1784–1846)

FRIEDRICH WILHELM BESSEL, the great German astronomer, was born on July 22, 1784, at Minden, about thirty miles east of Hanover. An aptitude for figures and a distaste for Latin led to his apprenticeship in his fifteenth year to a mercantile house in Bremen. Here he acquired a knowledge of English and Spanish, studied geography and navigation, and from these subjects he "groped his way into a new world of astronomy and mathematics". The works of Bode, von Zach and Lalande were his companions, and by their aid he deduced an orbit for Halley's Comet. The result he sent to Olbers, who immediately sent it to von Zach for publication, and thus Bessel's name became known. In 1805, Harding, Schröter's assistant at Lilienthal, was transferred to Göttingen, and Bessel, whose success in business was assured, renounced the prospect of comparative affluence for "poverty and the stars". Five years later he was chosen by the Prussian Government to superintend the erection of the new observatory at Königsberg, on the completion of which he was appointed director. Through his labours this establishment became the chief of German observatories and a centre of improvement for the whole astronomical world. Bessel remained at Königsberg for the rest of his life and died there on March 17, 1846.

Bessel's first great work appeared in 1818 under the title of "Fundamenta Astronomiæ". In this he gave to the world the results of his elaborate investigations of Bradley's observations made at Greenwich during 1750–62. "The eminent value of the work consisted in this, that by providing a mass of entirely reliable information as to the state of the heavens at the epoch 1755, it threw back the beginning of exact astronomy almost half a century" (Clerke). In 1830 Bessel published his "Tabulæ Regiomontanæ", which became the standard work of its kind. He had, in 1821, commenced observations of all stars down to the ninth magnitude comprehended within the parallels of 15° south declination and 45° north declination. In this he was assisted by Argelander. The observations amounted to 75,000 and they were not complete until 1833. He also determined the parallax of γ Cygni, he made many observations and physical inquiries on comets, he investigated the theory of the pendulum, discussed the figure of the earth, and also directed the operations for connecting the Russian triangulation with those of Western Europe. His name is also associated with the Bessel function; this mathematical form, developed by Bessel for research in planetary perturbations (1824), has been widely used in celestial mechanics, wave-theory, elasticity, hydrodynamics and related modern investigations.

Giulio Bizzozero (1846–1901)

THOUGH the memory of Bizzozero, the centenary of whose birth falls on March 20, is eponymously honoured in 'Bizzozero's corpuscles', it may be said without undue straining of the phrase that his signature is writ large upon many a page in the annals of

physiology and pathology. Virchow's ablest pupil, Bizzozero at the age of twenty-seven became professor of general pathology at Turin, where he proved himself an attractive lecturer, lucid both in thought and expression. Among the first to study the histology of experimental tuberculosis and to observe cell inclusions—pioneer work anticipating the conception of phagocytosis—he was an early student of the hæmopoietic function of bone-marrow, and in 1882 named the blood-platelets (first noticed by Donné in 1842 and more fully described by Osler in 1873), recognizing their participation in blood coagulation. His "Manual of Clinical Microscopy" (1885) went through several editions and translations. Forced by choroiditis to abandon microscopic work, Bizzozero enthusiastically plunged into sanitary reform. Tall, delicately built, with fine features, he was a victim of chronic neuralgia, which however failed to ruffle his serenity and to curb his mania for work. He died of pneumonia on April 8, 1901. Among his distinguished disciples, Golgi, Bassini and Foà have found international fame.

Deaths of Czech University Workers during the German Occupation

Dr. N. Wooster, "Brooklyn", Cherry Hinton Road, Cambridge, was recently in Czechoslovakia, and arranged with Prof. J. Bělehrádek, rector of the University Charles IV, to receive a list of the staff of Czech universities who died as a consequence of the German occupation. Some of those mentioned have already been referred to in the obituary columns of *Nature*; but it is of interest to have the complete list arranged, as Prof. Bělehrádek has done, by universities and faculties.

Caroline University: Faculty of Arts: six deaths. *Faculty of Medicine:* thirteen deaths, including Prof. Hynek Pelc, professor of social medicine (executed); Dr. Vladimír Bergauer, general biology (gassed with his wife at Mauthausen), and Dr. Vladimír Tůma, histology (beaten to death in the Pankrác Prison). *Faculty of Science:* Prof. František Záviška, professor of theoretical physics (died on his way from the concentration camp) (see *Nature*, March 9, p. 292); Prof. Václav Dolejšek, professor of physical chemistry (died in Terezín); Prof. Jan Auerhan, professor of statistics (executed); Prof. František Ulrich, professor of crystallography (mortally wounded while being arrested); Prof. Jaroslav Štorkán, professor of zoology (executed); Dr. Radim Nováček, mineralogy (executed).

Czech Technical Institute in Prague: Prof. Viktor Felber, professor of mechanics (executed); Prof. Jaromír Šámal, professor of zoology (executed); Prof. Leopold Šrámek, professor of general electrical technology (executed); Prof. Jindřich Svoboda, professor of spherical astronomy (died as a result of imprisonment); Otakar Runa, assistant lecturer in technical mechanics (executed); Oldřich Mirtes, assistant lecturer in technical mechanics (died in Auschwitz); Karel Kašík, assistant lecturer at the Institute of Hydraulics (executed).

Masaryk University (Brno): Faculty of Law: six deaths. *Faculty of Medicine:* Prof. Karel Horák, professor of anatomy (executed); Prof. Jan Florian, professor of histology and biology (executed) (see *Nature*, March 2, p. 257); Prof. Miroslav Křivý, professor of neurology and psychiatry (died in prison). *Faculty of Science:* Prof. Vojtěch Rosický, professor of mineralogy (executed); Prof. František Koláček, professor of geography (executed); Prof. Antonín Šimek, professor of physical chemistry (executed); Dr. František Schacherl (died in a concentration camp).

Beneš Technical Institute (Brno): Adolf Zobač (executed); Prof. Josef Sahánek, professor of technical physics (died in a concentration camp); Dr. Vladimír Němec (chemistry); V. Beneš; Dr. Jaroslav Mrkos, assistant lecturer; Dr. Bohuslav Hrdlička; Jaroslav Potoček, assistant lecturer; Prof. Bohumil Kladivo, professor of geodetics (died as a result of persecution); Dr. Bedřich Pospíšil, assistant lecturer (died as a result of persecution).

Veterinary Institute, Brno: Prof. Tomáš Vacek, professor of physiology (executed); Prof. Jan Bečka, professor of chemistry (executed).

Agricultural Institute, Brno: František Wenzel; Blahoslav Cermák, Commissioner for the Scientific Institutes (executed); Prof. August Bayer (died in Mauthausen); Dr. Vladimír Krist, assistant lecturer (died in a concentration camp).

Announcements

Sir Alexander Cadogan, permanent representative of Great Britain on the Security Council, has been appointed to represent the Government on the Atomic Energy Commission of the United Nations; Sir James Chadwick has accepted the appointment of scientific adviser and alternate representative of the United Kingdom on the Commission.

Sir Henry Dale, recently president of the Royal Society, Prof. James Gray, professor of zoology in the University of Cambridge, and Prof. D. M. S. Watson, Jodrell professor of zoology and comparative anatomy at University College, London, have been elected to the board of trustees of the British Museum.

The following appointments have been made at the University College of Wales, Aberystwyth. Mr. E. F. Nash, to be professor of agricultural economics and advisory economist; Mr. E. G. Bowen, lecturer in the Department of Geography and Anthropology, to be Gregynog professor of geography and anthropology.

The following appointments have been made in the University of Sheffield: Dr. T. E. T. Bond, to be lecturer in botany; Mr. J. D. Weston, to be assistant lecturer in mathematics.

A symposium on "Metrology" is being organised by the Royal Society and will be held in the Society's rooms at Burlington House, London, on March 21, commencing at 2.30 p.m. A number of short papers dealing with the principal units and standards used in scientific measurement will be read by the director and members of staff of the National Physical Laboratory.

A discussion on "Some Aspects of the Chemistry of Macromolecules", arranged by Prof. H. W. Melville, will be held at the Chemical Society, Burlington House, London, on April 4 at 2.30 p.m. Those taking part will include: Mr. C. W. Bunn, Prof. M. G. Evans, Dr. G. Gee, Prof. M. Polanyi and Dr. H. W. Thompson.

The Board of Trade states that some two hundred German scientific workers and technicians have volunteered to work in Great Britain for a limited period in an advisory capacity. These men will be employed by the Government, which will lend them to trade associations and research organisations.

LETTERS TO THE EDITORS

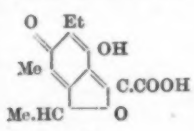
The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Citrinin

WORKING with certain "local fungi in Bombay", Manohar[1] incorporated into a "therapeutic drug called Notalin" the purified metabolic products of a species of *Penicillium* (*KG*) and of *Aspergillus* (*M* 82). Notalin, marketed as a yellow powder, crystallizes from alcohol in yellow needles, m.p. 171·5° C., and has proved to be identical with citrinin[2], for a sample of which we are indebted to Dr. A. E. Oxford. A pure strain was then isolated from "*Penicillium KG*", which has now been kindly identified for us by Dr. G. Smith as *Penicillium citrinum*, Thom. Citrinin was first isolated by Hetherington and Raistrick[3] from *Penicillium citrinum* Thom., and later from *Penicillium expansum*[3], *Aspergillus terreus*[4] and an *Aspergillus* species of the *candidus* group[5]. Citrinin has also been isolated in 1–1·2 per cent yield from the dried leaves of the flowering plant, *Crotalaria crispata*, growing in tropical north Australia[6].

While Raistrick and Smith[7], in contrast to Manohar, have been careful in stating that no claims were made regarding the value of citrinin as a chemotherapeutic agent, pending extensive pharmacological tests, citrinin remains of unusual interest as an antibacterial substance on account of its stability and the high yields in which it can be obtained. Hetherington and Raistrick were able to isolate 2 gm. of citrinin per litre of metabolism solution; and the yield using Manohar's organism was 1·5 gm. per litre.

Citrinin is a phenol carboxylic acid, and Coyne, Raistrick and Robinson[8] have suggested a structure (I) for citrinin in which all the positions of the benzene ring are occupied. We find, however, that citrinin couples readily under the usual conditions with diazotized *o*-chloraniline, 2 : 5-dichloraniline, and sulphanilamide, to yield the corresponding mono-azo dyes.



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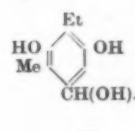


(II)

Analysis indicated no displacement of any of the groups in the citrinin molecule during coupling under specified conditions. Thus, the dye from dichloraniline crystallized from chloroform in lustrous reddish orange leaflets, m.p. 200–201° (decomp.); (found: N, 6·3; Cl, 17·3. $C_{17}H_{11}O_5N_2Cl_2$ requires N, 6·6; Cl, 16·8 per cent); and a solution of the dye in alcohol titrated correctly for a monocarboxylic acid. In view of the probable quinonoid character of citrinin, other possibilities for its interaction with diazo salts have been examined, but there is no doubt that coupling takes place in the normal manner, in the *ortho* or *para* position with respect to the phenolic hydroxyl, so that structure (I) for citrinin becomes untenable. A notable property of the benzeneazocitrinins is their stability to boiling dilute sulphuric acid, which hydrolyses citrinin itself[7,8] to carbon dioxide, formic acid and a dihydric phenol, $C_{11}H_{14}O_4$; it would appear that tautomerization from the quinonoid to a stable aromatic form is involved.

Using excess of diazotized aniline and varying conditions of hydrogen ion concentration, the coupling reaction was complex. The major product was always the monoazo dye m.p. 182° (decomp.) (found: N, 8·2. $C_{23}H_{18}O_5N_2$ requires N, 7·9 per cent); but another dye could also be isolated: red needles, m.p. 205° (found: N, 14·8 per cent). In the formation of the second dye, degradation of the citrinin molecule must take place, and the behaviour of diazo salts towards the fission products of citrinin was therefore studied.

By the action of boiling 5 per cent sulphuric acid on citrinin, Hetherington and Raistrick obtained two compounds (*A*) and (*B*), which were optical isomers and to which the structure (II) was assigned[7]. Product (*A*) couples with diazotized 5-nitro-*o*-anisidine to form a *disazo* dye, which shrinks at 320°, but does not actually melt to a clear liquid below 350° (found: N, 15·2. $C_{31}H_{24}O_7N_4$ requires N, 15·2 per cent). Thus the structure (II), which has only one coupling position, needs to be modified. Product (*A*) behaves abnormally with excess of diazobenzene chloride, giving a wine-red dye, m.p. 205°, identical with the dye of the same melting point obtained by coupling citrinin itself with diazobenzene chloride (found: N, 14·8, 14·9, 14·8. $C_{31}H_{24}O_7N_4$ requires N, 13·9 per cent); the higher nitrogen content in comparison with the theoretical requirement for the *bis*benzeneazo-derivative of product (*A*) of the molecular formula $C_{11}H_{14}O_4$ must involve the displacement of a group.

Fusing product (*A*) with potassium hydroxide as described by Hetherington and Raistrick, the phenolic product, formulated by Coyne, Raistrick and Robinson[8] as 2-ethyl-4-methyl-resorcinol, crystallized from benzene in long colourless needles, m.p. 68–69°. The substance loses one molecule of water on heating and then melts at 98–99° (Hetherington and Raistrick, 97–99°). Robinson and Shah[9] have mentioned that an old sample of the product, which had apparently deteriorated, melted at 65–70°; while synthetic 2-ethyl-4-methyl-resorcinol melted at 98–99°. The substance of m.p. 68–69° prepared by us gave a chocolate *disazo* dye, m.p. 274–275°, on coupling with diazotized 5-nitro-*o*-anisidine (found: N, 16·4. $C_{31}H_{30}O_9N_8$ requires N, 16·5 per cent).

We understand from a private communication to one of us by Sir Robert Robinson that he is re-examining the constitution of citrinin.

Our thanks are due to Dr. R. G. Chitre for referring this problem to us and for a supply of citrinin.

T. S. GORE.
T. B. PANSE.
K. VENKATARAMAN.

Department of Chemical Technology,
University of Bombay.
Nov. 28.

[1] Manohar, *Ind. Med. Rec.*, **65**, No. 1 (1944).
[2] Hetherington and Raistrick, *Phil. Trans. Roy. Soc.*, **220**, 269 (1931).
[3] Oxford, "Annual Review of Biochemistry", **14**, 757 (1945).
[4] Pratt *et al.*, *Science*, **99**, 351 (1944).
[5] Timonin, *Science*, **96**, 494 (1942).
[6] Auwart, *Ann. Bot.*, **47**, 913 (1933).
[7] Raistrick and Smith, *Chem. and Ind.*, **60**, 829 (1941).
[8] Coyne, Raistrick and Robinson, *Phil. Trans. Roy. Soc.*, **220**, 297 (1931).
[9] *J. Chem. Soc.*, 1491 (1934).

An Antibacterial Pigment from *Fusarium javanicum*

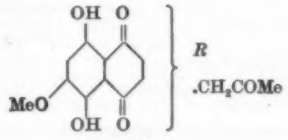
IN examining fungi for antibiotic metabolic products[1], several were observed to inhibit the acid-fast *Mycobacterium phlei*. In view of the possibility of their inhibiting the closely related *M. tuberculosis*, the responsible materials are being studied more closely, and the present communication reports some results with a single mould which appear to be of general interest.

During a brief initial survey, promising results were obtained from, among others, a number of Fusaria, and especially from a strain of *F. javanicum*. Apart from cursory reference to the inhibition of *E. coli* by this species[2], which incidentally was not observed in the present work, this seems to be the first time that this fungal class has featured in connexion with antibiotics. It soon became apparent that the antibacterial action of *F. javanicum* filtrates was associated with a pigment, production of which reached a comparatively high level on media containing glucose and 'Bactotryptone' and similar preparations as the sole source of nitrogen; under other conditions antibiotic solutions were obtained which were not pigmented.

The active pigments were present almost entirely in the dark red solution, with very little in the mycelium; in the few instances in which *Fusaria* pigments were examined by previous workers they were isolated from the mycelium[3], although a pigment which may not be dissimilar from that described below was detected in the medium surrounding a *Fusarium* culture[4]. In the present instance, up to 0·1 gm. of crystalline pigment was obtained from 1 litre of culture solution. The active material consisted of part only of the mixture of similar colouring matters present, so that a selective antibacterial action was indicated. The active fraction contained at least two entities which were very similar in antibacterial and general chemical properties.

One pigment formed red laths with a coppery lustre, m.p. 208° (decomp.), and could be extracted from aqueous solution by ether or benzene, but only with difficulty by light petroleum. From organic solutions it was removed by extracting with aqueous sodium carbonate or stronger alkali. It gave a magnificent violet colour in alkali which, apart from solubility and other properties, distinguished it from rubrofusarin[2,4], another *Fusarium* pigment. It had the molecular formula $C_{15}H_{14}O_6$, and as it does not seem to have been encountered before, the name 'javanicin' is proposed for it. Javanicin titrated as a monobasic though very weak acid and clearly contained no carboxyl group. It contained a quinone grouping and was spectrally very similar to hydroxydroserone (3 : 5 : 8-trihydroxy-2-methyl-1 : 4-naphthoquinone)[5], which is also stated to give an intense violet colour with alkali[5]. It is doubtful whether javanicin contained three hydroxyl groups despite its containing three active hydrogen atoms, for on acetylation it gave a yellow anhydromonoacetyl derivative, $C_{17}H_{16}O_7$, m.p. 247–248°; the latter exhibited the anticipated spectrum of a naphthoquinone (compare ref. 5) although it probably contained an additional (furane ?) ring.

Javanicin contained one methoxyl group, and afforded two molecules of volatile fatty acid on oxidation (Kuhn Roth estimation). There was no evidence of an olefinic double bond on catalytic reduction, but the pigment yielded much iodoform on oxidation with alkaline hypoiodite and bromoform with hypobromite. These facts are consistent with the partial formula (I) (R = Me), a β- rather than α-methoxy group being more probable. The second pigment formed needles, m.p. 212°, and had the composition corresponding to $C_{15}H_{14}O_7$. It appeared to form a molecular compound, m.p. 178°, with javanicin. The light absorption of the second pigment was strikingly similar to that of javanicin. It also gave iodoform on oxidation, but contained only one side-chain affording volatile fatty acid in the Kuhn Roth estimation. These facts seem best accommodated by the partial formula (I) (R = CH_2OH), and the term 'oxyjavanicin' seems appropriate for this pigment.



(I)

Javanicin inhibited the growth of *Staphylococcus aureus* and *Mycobacterium phlei* at a dilution of 1 : 400,000 (another strain of *M. phlei* was about half as sensitive), and was about as active towards *B. subtilis* and *Bact. fasciens*; but it was much less active or inactive towards *Strep. pyogenes* and Gram organisms (*E. coli*, *B. pyocyaneus*, *B. fluorescens liquefaciens*, *Bact. tumefaciens*). The anhydromonoacetyl derivative showed a similar range of activity. Referring to preliminary

in vitro tests with human-type tubercle bacillus, Prof. W. H. Tytler, Welsh National School of Medicine, Cardiff, to whom our thanks are due, stated that there was a fairly sharp end-point showing practically complete inhibition of growth at 1 : 50,000–1 : 100,000 ; the inhibition was apparently permanent (towards other organisms the effect was a bacteriostatic one in low concentrations, but bactericidal in stronger solution) and was not affected by at least moderate concentrations of serum. This grade of activity is comparable to the most powerful of various experimental drugs hitherto known which could possibly be used in human treatment. In further tests kindly carried out by Dr. A. T. Fuller, National Institute for Medical Research, London, the pigment was active at *c.* 1 : 100,000 against a haemolytic *Streptococcus* and active also against *Clostridium welchii*. In mouse tests a dose of 10 mgm. was tolerated, so that the pigment seems relatively non-toxic.

Details of this work will be published elsewhere ; meanwhile fuller chemical and biological examination of the materials mentioned above and the similar ones from other Fusaria is being carried out, as well as appropriate synthetic work.

Our thanks are due to Prof. I. M. Heilbron, for his interest and encouragement, and to the Rockefeller Foundation and Medical Research Council for financial assistance.

H. R. V. Arnstein.
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Biologically Active Metabolic Products of the Mould *Metarrhizium glutinosum* S. Pope

In 1944 we obtained a culture of a *Metarrhizium* sp. from the United States Department of Agriculture, which had been described by Greathouse, Klemme and Barker[1] as an active decomposer of cellulose, particularly suitable for *in vitro* assessment of textile preservative treatments. This fungus was afterwards described by Pope[2] as a new species, *M. glutinosum*. Our organism agrees with Pope's description. We have found that this mould, when grown on a variety of synthetic media, produces fungistatic culture filtrates. From cultures of this mould on Raulin Thom medium, supplemented by 0·01 per cent 'Difco' yeast extract, we have isolated a substance for which we propose the name 'glutinosin', in yields of the order of 15 mgm. per litre of culture filtrate.

Glutinosin can be isolated from active culture filtrates by extraction with ether, *n*-butyl alcohol or petroleum ether. We have found the latter solvent preferable. By evaporation to dryness and crystallization from ethyl alcohol, glutinosin is obtained as thin, colourless plates. These crystals do not melt at 300° C. and they only darken slowly at this temperature ; they contain no sulphur, nitrogen or halogens and give no ash on combustion. Analyses are given in Table 1. Glutinosin is optically active ; for a 0·2 per cent solution in benzene, $[\alpha]_D^{26}$ is approximately + 54°.

Table 1.

	I	II	$C_{24}H_{40}O_{11}$ requires
C%	64·7	65·2	64·6
H%	6·7	7·0	6·8
Molecular weight (Rast)	920	755	892·7

Glutinosin is somewhat specific in its antifungal activity. In Table 2 is shown the minimum concentration needed to inhibit completely germination of spores of a number of fungi, at *p*H 3·5. The variation in the effect of glutinosin on different species is noticeable. Glutinosin is not markedly antibacterial ; growth of *St phylococcus aureus*, *Salmonella typhi* and *Escherichia coli* is not inhibited by concentrations of 100 µgm./ml. Aqueous solutions of glutinosin are relatively stable. At 25° C. aqueous solutions maintained their fungistatic activity unchanged for 10 days in a *p*H range of 2·9–7·6 ; at *p*H 8·4 there were indications of slight loss of activity. Thus, like viridin[3], glutinosin is a specifically antifungal antibiotic, but is much more stable.

Table 2.

Fungus species	Least concentration (µgm./ml.) of glutinosin preventing spore germination
Botrytis allii Munn	0·2
Penicillium expansum Thom	25·0
P. digitatum Sacc.	1·0
Fusarium carruleum (Lib.) Sacc.	0·8
F. graminearum Schwabe	>50·0

Glutinosin is not the only biologically active material produced by *M. glutinosum*. After handling the first large-scale cultures of this mould, one of us suffered from severe facial inflammation, followed by desquamation of the skin. There was considerable local irritation ; the eyelids were particularly painful. We have since established the fact that, if a little culture filtrate is applied to the upper arm, a typical inflammation appears in forty-eight hours. All of six subjects tested were sensitive, though in varying degrees. The symptoms produced are similar to those described for the dermatitis caused by contact with poison ivy (*Rhus toxicodendron*). The substance responsible for this effect is extracted along with glutinosin by the methods described above, and remains in the alcoholic mother liquors after the glutinosin has crystallized out. Glutinosin has no irritant properties. So far as we are aware, this is the first record of the production by a mould of a substance with these properties. We have found it necessary to make liberal use of barrier creams when working with cultures and culture extracts of this mould.

Work on the chemical and biological properties of these substances is being continued, and our results will be reported in greater detail elsewhere.

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Antibiotic Material from *Bacillus licheniformis* (Weigmann, *emend.* Gibson) Active Against Species of Mycobacteria

About a year ago, one of us (P. D'A. H.) made the observation that sterile filtrates from cultures of a stock strain of a micro-organism, believed to be *Bacillus subtilis*, exerted an inhibitory action on the growth of *Mycobacterium phlei*. The organism has now been identified as *Bacillus licheniformis* (Weigmann, *emend.* Gibson) and a considerable advance has been made in the concentration of an active material, which is found to be inhibitory *in vitro* also against *M. tuberculosis*. A preliminary account of our results is now communicated because of reports which have appeared recently of the presence of antibiotic material in cultures of *B. subtilis*. One of these reports[1] first came to our notice, and the others[2–5] were published, while our own investigation was in progress. It is possible that some of these investigations, as well as earlier ones[6–12], may deal with the same species as we have used, since *B. licheniformis* is not always distinguished from the closely related *B. subtilis* and the distinction has not, in fact, been recognized universally[13]. Identity of our chief fraction of active material with either 'subtilin'[4] or 'bacitracin'[2] does not seem likely, for certain properties of subtilin do not agree with those of our material—notably the solubility of the former in aqueous ethanol—and the method of extraction of bacitracin is not applicable to our material.

B. licheniformis is grown on an autoclaved synthetic medium containing in one litre potassium monohydrogen phosphate 1 gm., sodium citrate 0·5 gm., magnesium sulphate ($MgSO_4.7H_2O$) 1 gm., asparagine 5 gm., glucose 30 gm., iron ammonium citrate 17 mgm., manganese sulphate 3 mgm., distributed in shallow layers in flasks. Solutions of the last three components are sterilized separately before mixing. Inoculation of the medium by *B. licheniformis* is carried out by adding to it 2 per cent of its volume of a culture grown in half-filled test tubes of a similar medium. Sucrose appears to give a lower yield of antibiotic activity than glucose ; glycerol gives good growth but negligible activity. The cultures are kept at 37° and are harvested in from six to twelve days.

It was found early in the investigation that filtrates obtained by passage through Seitz-type filters had little activity in comparison with the product of autoclaving the culture at a *p*H between 2 and 3. This led directly to the conclusions that the active material was thermostable and, moreover, was bound to the bacterial bodies and was brought into solution by heating with very dilute acid. Autoclaving was adopted as the routine method of sterilizing for test purposes, particularly as there was evidence that the filters used adsorbed the active material.

Two methods have been employed for the first stage of the extraction. Either the culture is acidified to *p*H 2·5 and treated with 3 volumes of 95 per cent ethanol and the coagulum is collected and extracted by boiling with 0·5 volume of 0·4 per cent acetic acid for 45 minutes, or the culture is brought to *p*H 2·5 and autoclaved at 10 lb./in.² steam pressure for 10 min. The supernatant solution obtained after centrifugation of the product in either case is treated with 4 volumes of 95 per cent ethanol and the precipitate is collected. Small amounts of an inactive picrate have been obtained from this material and active material recovered by precipitation of the supernatant solution with ethanol. The white solid thus obtained, in a yield of 0·9–1·8 gm. from 1 litre of culture, is soluble in water, giving viscous solutions. It gives positive Molisch and Sakaguchi tests. Active material dialysed slowly through a cellulose membrane.

The biological activity of this crude concentrate has been more fully investigated than that of the more highly purified extracts, free from polysaccharide, which have now been obtained. Solutions in water are prepared for test by sterilization at *p*H 2–3 for 10 minutes under 10 lb./in.² steam pressure and serial dilutions are made in broth. 5 ml. of broth are inoculated on the surface with *M. phlei* and growth is observed after four days at 37°. The highest dilution at which inhibition is complete is observed, and the reciprocal of this figure is taken as the number of units in 1 ml. of the test solution. Cultures containing 320–1,280 units per ml. have yielded crude concentrates containing 100,000–300,000 units per gm. of solid, and, in general, about 50 per cent of the original activity is recovered. Crude concentrates having activity of this order against *M. phlei* inhibited the growth of *Staph. aureus* at 1 : 80,000, and of *B. licheniformis* at 1 : 10,000, when incubated in broth for 18 hours at 37° ; *E. coli* was not inhibited at 1 : 5,000. In broth containing 50 per cent of horse serum, growth of *Staph. aureus* was inhibited at 1 : 40,000. Inhibition of growth of a virulent human type of *M. tuberculosis* grown for three weeks in deep culture in a modified Kirchner medium occurred at a dilution of 1 : 20,000. The crude concentrate was tolerated by mice

in doses of 20 mgm. intraperitoneally or 2 mgm. intravenously. Larger doses were not tried.

Further fractionation of the crude concentrate has yielded an active precipitate, free from carbohydrate, with Reinecke's salt, and a polysaccharide fraction which is devoid of activity. From the Reineckate an amorphous material has been obtained which gives a positive Sakaguchi test and has an activity of 800,000 units per gm.

It seems likely that more than one antibiotic material is present in cultures of *B. licheniformis*; there is evidence of an ethanol-soluble material not separated by the method of fractionation described here and, moreover, the Reineckate fraction may contain more than one active compound. Work is being continued and will be reported in detail elsewhere.

Our grateful acknowledgments are due to Mrs. J. Bedford for carrying out the preliminary tests of toxicity, and to Dr. T. Gibson for identifying the organism.

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Occurrence of Inorganic Pyrophosphate in Baker's Yeast

The isolation and purification by Bailey and Webb[1] of a phosphatase, which acts specifically on inorganic pyrophosphate, makes probable the occurrence in baker's yeast of this compound as a natural metabolite. That inorganic pyrophosphate may be accumulated under certain conditions in baker's yeast is revealed by the experiments described below. Studying the mechanism of the inhibition of the respiration caused by the lithium ion in baker's yeast, we had observed the accumulation of an easily hydrolysable phosphate compound. This was prepared in the following way. In 5 l. of 0·080 *M* sodium potassium succinate buffer of *p*H 5·0, the [*F*'] of which was 1/10 of its total alkaline ion concentration, sufficient lithium chloride was dissolved as to make the solution 0·40 *M* with respect to lithium. In this solution 170 gm. fresh yeast was suspended and a powerful stream of oxygen was bubbled through the mixture (temperature, 20° C.). After one hour, the lithium now being in equilibrium with the interior of the cells, 5·4 gm. of glucose was stirred into the mixture and the aeration continued for another thirty minutes. At the end of this time the sample was fixed by addition of perchloric acid. The yeast cells were extracted at 0° C., the *p*H of the liquid raised to 8 and the cells centrifuged off. The clear extract was treated with excess barium chloride. The precipitate was centrifuged down, dissolved in normal hydrochloric acid and the clear solution again precipitated with barium chloride at *p*H 4·5. The barium salt thus obtained was purified by repeated precipitation.

Combustion of the isolated compound yielded neither carbon nor nitrogen. When it was hydrolysed with normal hydrochloric acid at 100° C., its total phosphorus appeared as orthophosphate within seven minutes, which is similar to the behaviour of pyrophosphate. The barium salt was converted into the sodium salt. The percentage of phosphorus in the anhydrous sodium salt proved to be 23·95, the figure for $Na_4P_2O_7$ being 24·00. The identity of the isolated substance with inorganic pyrophosphate was thus demonstrated.

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Preparation of Purified Azoprotein Antibodies

Purified antibodies to bacterial polysaccharides have been prepared by extracting the antigen-antibody precipitates with solutions of either calcium hydroxide[1] or sodium chloride[2]. These methods fail, however, when applied to protein antigens, because the solubility of these antigens is similar to that of the antibody proteins.

Taking advantage of the insolubility of azoproteins[3] at a *p*H less than 6, we have extracted antibodies to azoproteins from the antigen-antibody precipitates by different acid solutions. Attempts with buffer solutions of *p*H 3–6 failed to give any result. Extraction with diluted acetic acid[4,5] furnished feebly active antibody solutions. But a high yield of antibody was obtained by a brief extraction of the precipitates with cold 0·05–0·5 *N* hydrochloric acid.

The anthranil-azoglobulin used in these experiments as antigen was prepared by coupling pseudoglobulin from sheep serum with diazotized anthranilic (= *o*-amino-benzoic) acid. Similar results were obtained with *met*-anil-azoglobulins. But antibodies to arsanil-azoglobulin could not be recovered from their antigen-antibody compound. The methods of preparation of the azoproteins, of their injection into rabbits, of the precipitation of the immune sera and the analytical methods have been described previously[6,7]. The preparation of the purified antibodies is illustrated by the following experiment.

25 ml. of an immune serum to anthranil-azoglobulin were precipitated by the addition of 9 ml. of the antigen. The precipitate was washed three times with saline solution, mixed with 9 ml. of a chilled solution of 0·05 *N* hydrochloric acid containing 5 per cent of sodium chloride, kept at 0° for 5 minutes and centrifuged for a short time. The insoluble residue weighed 23·2 mgm. and contained 8 mgm. of the antigen. The supernatant colourless antibody solution was at once neutralized by 0·1 *N* sodium hydroxide. Traces of insoluble material were removed by centrifuging. The volume of the neutral antibody solution was 14·5 ml. 1 ml. of this solution contained 0·195 mgm. of nitrogen (Kjeldahl), that is, 1·22 mgm. of protein. 13·5 ml. of the same solution, when precipitated fractionally three times each with 3 mgm. of the antigen, furnished 19·0 mgm. of a precipitate containing 5·7 mgm. of the antigen.

These results show that 54 per cent of the antibody present in the antigen-antibody precipitate were extracted by hydrochloric acid, and that at least 81 per cent of this antibody was active, that is, precipitable by the homologous antigen.

The advantage of the simple method described above is that it furnishes in a single step a highly purified antibody, the solution of which contains no other salt than sodium chloride. The antibody solution is colourless, hence free from antigen, for even traces of azoproteins show a distinct brown colour. The active antibody is a mixture of at least two globulins, since part of it is precipitated by one-third saturation with ammonium sulphate, while the remainder requires half-saturation for its precipitation.

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Alcoholic Fermentation of Carbohydrates and Dehydrogenation of Alcohols by Certain Wood-destroying Fungi

In recent years, the biochemistry and enzymology of Fusaria have received considerable attention in this laboratory. These moulds are characterized by their ability to ferment hexoses and pentoses, bypassing the phosphoglyceric acid step. They are able to reduce nitrates via nitrite to hydroxylamine, to utilize potassium cyanide as a carbon and nitrogen source and elementary sulphur as a hydrogen acceptor, to synthesize a variety of pigments which can serve as mediators between oxidation and assimilation, and to convert carbohydrates abundantly into fats[1].

In the light of the versatility of these organisms, it was deemed advisable to attempt a renewed approach to the problem of wood decay. Comparatively few tangible facts are available in this field[2], and it was therefore considered desirable to attempt a preliminary attack on the problem in its fundamentals, and first examine the course of oxidation of glucose, xylose, raffinose and cellulose and the dehydrogenation of sorbitol and isopropyl alcohol by three different *Merulia* and *Fomes annosus*.

It was found that these organisms are perfect alcoholic fermenters, producing stoichiometric amounts of alcohol from the first three carbohydrates aerobically, and it would appear at present that phosphorylation does not constitute an integral part of the phase sequence of their degradation. The dissimilation of raffinose by *Merulius niveus* proceeds more rapidly than that of glucose, just as in the case of the *Fusarium* fermentation of trehalose. It was also noticed that the ethyl alcohol so formed is subject in all cases to a dehydrogenation, whereby substantial amounts of acetaldehyde and acetic acid could be isolated (without trapping) and identified.

The accumulation of acetic acid under anaerobic conditions amounted to four times that obtained aerobically, and points to a direct dehydrogenation of ethanol when given as a carbon source. However, it would still be conceivable that two processes are progressing simultaneously, namely, (*a*) a dehydrogenation of the acetaldehyde formed under participation of oxygen or, and especially so under anaerobic conditions, (*b*) a dismutation of two molecules of acetaldehyde resulting in the formation of acetic acid and ethanol. However, an oxidative decarboxylation of pyruvic acid (which, contrary to *Fusarium* fermentations, was *not* isolated) may also have occurred.

As to the phase sequence of the anaerobic degradation of cellulose by our *Merulia* and *Fomes annosus*, the evidence so far available shows that, in addition to ethanol, traces of acetic acid were found. This result is at variance with the mechanism of a cellulose fermentation by anaerobic or thermophilic bacteria as outlined by Lyman and Langwell[3].

The conversion *d*-sorbitol → sorbose → 2-keto-*l*-gulonic acid represents, in distinction to the direct dehydrogenation of isopropyl alcohol to acetone, a more complex system. To visualize the progress of the former reaction we utilized resazurin[4], which acted as an excellent hydrogen acceptor, synthesized in such a way as to exclude admixture of resorufin. The utilization of a strong oxidizing agent, sodium peroxide, prevented the possibility of simultaneous formation of this contaminant.

The results obtained with these substrates corroborate our findings on the presence of a dehydrogenating enzyme system in the four wood-

destroying moulds used. In the case of sorbitol, it was also observed that while there is a decrease in mycelial weight, the reducing-compound content continues to increase. This would lead one to assume that due to apparent 'starvation' of the mycelium, the ability of the dehydrogenases present to act upon *l*-sorbose is destroyed, simultaneously preventing formation of the 2-keto-*l*-gulonic acid.

In the case of the dehydrogenation of isopropyl alcohol, it was noticeable that, in contrast to earlier findings with Fusaria, the moulds employed in the present study did not give rise to the hydroclastic formation of formaldehyde as a secondary dissimilation product of this alcohol.

A detailed account of the study presented in this communication will appear in *Archives of Biochemistry*.

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Inactivation of Insulin by Intermediary Fat Metabolism Products

It has been recorded by several workers that insulin, though effective in most diabetics in lowering the blood-sugar level to normal, in a small fraction of cases either does not react at all or very high doses are required for beneficial results. Rosenthal[1] observed that one of his patients showed no relief in hyperglycæmia even by daily injections of 100–120 units of insulin. Isolation of inactive insulin has been reported by Bhima Rao *et al.*[2], and Himsworth[3] reports on diabetics insensible to insulin. Joslin[4] regards adiposity as a precursor of diabetes and this idea has recently been supported by our evidence[5] that disturbance in the intermediary metabolism of fat is one of the factors responsible for the onset of hyperglycæmia. It has also been observed that hyperglycæmia caused by repeated injections of pyruvic acid, aceto-acetic ester, and β-hydroxy butyric acid, etc., is followed by a rapid fall in blood-sugar level, thus suggesting the possibility of extra stimulation of islet cells. This is to be expected when there is a chance that the internal insulin may be destroyed or inactivated by such substances when administered to the system.

We have undertaken investigations in connexion with this hypothesis. Adult rabbits weighing about 2 kgm. were selected as experimental animals; the keto-acids and esters in different proportions mixed with different quantities of insulin were injected into the fasting animals intramuscularly and their effect on the blood-sugar level studied at regular intervals, according to the method of Hagedorn and Jensen[6]. In a second series of experiments, the substances were injected separately, insulin being given 15 minutes after the injection of the substances, in order to find whether similar inactivation may also take place *in vivo*. Results are shown in the accompanying table.

While performing the *in vivo* experiments with aceto-acetic ester and pyruvic acid, it was observed that if these substances are used in small amount (say, 100 mgm.) and insulin (1 unit) injected at a different site, for example, in another leg, the average percentage

INFLUENCE OF KETO-BODIES ON THE INACTIVATION OF THE EFFECT OF INSULIN.

(Mean results for groups of 4 rabbits.)

Substance studied	Mean dose of		Blood sugar values (mgm./100 ml.) at				Average per centage reduction*
	Insulin (units)	Substance (mgm.)	0 hr.	1 hr.	2 hr.	3 hr.	
A (*in vitro*).	The substances mixed with insulin *in vitro* before injection.						
Aceto-acetic ester	(i) 0·69	0	134	98	108	123	18
	(ii) 0·69	162·5	129	111	113	124	10
Pyruvic acid	(i) 0·50	0	138	118	116	131	12
	(ii) 0·50	125	138	134	127	130	6
Sodium aceto-acetate	(i) 1·00	0	120	72	80	110	28
	(ii) 1·00	200	123	96	100	118	15
B (*in vivo*).	The substances injected and followed by insulin at the same site.						
Aceto-acetic ester	(i) 1·00	0	102	68	77	92	23
	(ii) 1·00	125	101	84	70	88	20
	(iii) 1·00	210	100	93	90	99	6
Pyruvic acid	(i) 1·00	0	97	61	71	90	24
	(ii) 1·00	125	98	75	72	95	18
	(iii) 1·00	200	100	90	87	98	8
Sodium aceto-acetate	(i) 1·00	0	99	60	75	84	26
	(ii) 1·00	150	100	78	79	95	16
	(iii) 1·00	210	105	90	95	100	10

* The figures in this column were calculated as follows: the blood-sugar values at 1, 2 and 3 hours were averaged and the value subtracted from the initial value; this gave the total reduction. The percentage reduction was then calculated.

reduction is sometimes found to be somewhat higher than with insulin alone. This may indicate slight stimulation of the keto-bodies on the insulin-secreting mechanism in the system.

A group of three animals was then selected for continued daily injection of 200 mgm. of aceto-acetic ester for four days; and when insulin (1 unit) was given on the fifth day just after injection of 200 mgm. of ester, no reduction of blood-sugar was observed; on the contrary, a very big rise (average 66 per cent) was observed, thus showing the complete inactivation of insulin.

It is thus evident that the intermediary fat metabolism products, particularly the keto-acids and esters, are responsible for causing partial or complete inactivation of insulin and sometimes give rise to what is known as 'insulin-refractory' cases. It has further been shown that such inactivation takes place *in vitro* as well as *in vivo*; in the latter case the amount of the keto-bodies required being somewhat higher than in the former. This may lead to new views on the control of the diabetic condition by giving a stimulus to the appropriate metabolic processes, particularly of fat, and may explain the finding of Rabinowitch[7], who believes that plasma lipid is the important index of the condition of diabetics and that the determination of blood cholesterol, which is directly proportional to lipids, affords a better measure of the severity of diabetics than does the determination of blood sugar. It also supports recent work of Nath and Chowdhury[8], who hold that hyperglycæmia is best relieved by treating metabolic disorder, thus doing away with the source of insulin inhibitors. Further work is in progress.

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Fermentative Formation of Diacetyl

According to Martius' recent hypothesis[1], dehydrogenation would always constitute the primary phase of pyruvic acid breakdown in the animal organism. Dehydrogenation is followed by decarboxylation, with the formation of the ketene-like radical $CH_2{-}C{=}O$, which may act as hydrogen acceptor, being reduced to acetaldehyde. This radical could also react with the acetaldehyde present, to form diacetyl, which again could act as hydrogen acceptor, and be reduced to acetylmethylcarbinol:

$$CH_3{-}C{=}O + CH_3.CHO \rightarrow CH_3.CO.CO.CH_3 \xrightarrow{+H_2} CH_3.CH(OH).CO.CH_3$$

Lipmann's work[2] has already showed that diphosphothiamine acts both as cocarboxylase and also as an active component in the dehydrogenation of pyruvic acid. However, detailed information has been lacking of the different phases of pyruvic acid dehydrogenation.

Recent investigations by Myrbäck and co-workers[3] now seem to have cleared up the main features of this problem. They have shown that diphosphothiamine in yeast exists also in the oxidized form, as disulphide (diphosphothiamine-SS). This indicates that thiamin really forms a redox-system of well-known type, like cysteine-cystine or GSH−GSSG, as suggested already by Zima, Ritsert and Moll[4].

Myrbäck's work also gives a starting-point for the experimental investigation of Martius' hypothesis. In baker's yeast all the thiamine exists in the disulphide form which, in anaerobic fermentations, is easily and quantitatively reduced, chiefly into cocarboxylase. On the other hand, the thiamine in brewer's yeast is mostly in the form of cocarboxylase, which remains quantitatively unchanged even during aerobic, aerated fermentations. Likewise, the disulphide form in it remains unreduced in anaerobic fermentations.

If, then, the disulphide form of diphosphothiamine acts as an active component in the dehydrogenation of pyruvic acid, and if the dehydrogenation of pyruvic acid is an essential condition for the formation of aroma substances—diacetyl, acetylmethylcarbinol and 2,3-butylene glycol—this fact ought to manifest itself in parallel fermentations with baker's and brewer's yeasts under anaerobic and aerobic conditions. In anaerobic fermentations, brewer's yeast would be expected to produce more aroma substances than baker's yeast, while the reverse ought to be true in aerobic, aerated fermentations. The accompanying table shows that this is indeed the case.

Yeast	Fermentation	Hours	Saccharose fermented %	Aroma substances (mgm. per 100 gm. fermented sugar)		
				Acetylmethylcarbinol	2,3-Butylene glycol	Total
Baker's	anaerobic	26	99·0	0·0	25·5	25·5
Brewer's		26	96·0	0·0	64·2	64·2
Baker's	aerobic	21·5	99·6	68·6	186·5	255·1
Brewer's	"	27·5	98·2	12·2	87·2	99·4

The fact that diacetyl has not been found in sugar fermentations by yeast can be ascribed to an immediate reduction of the primarily produced diacetyl. In order to lessen the possibility of such reduction, pyruvic acid was used as substrate. With dry brewer's yeast, formation of diacetyl under strictly anaerobic conditions could in fact be demonstrated by the analytical method of Langenbeck, Wrede and Schlockermann[5].

These experimental results support Martius' hypothesis that dehydrogenation of pyruvic acid is an essential condition for the formation of the aroma substances, and that in fermentations this process through the stages diacetyl → acetylmethylcarbinol → 2,3-butylene glycol. They likewise support Myrbäck's view that the disulphide form of diphosphothiamine takes an active part in the dehydrogenation of pyruvic acid.

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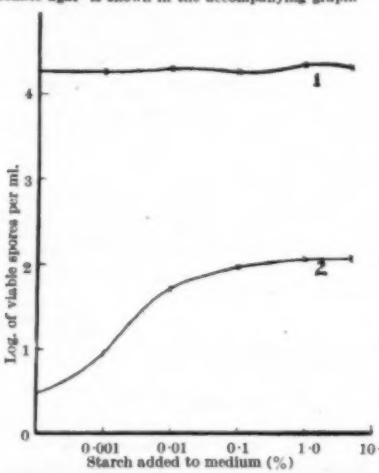
Influence of Starch in Media Used for the Detection of Heated Bacterial Spores

DURING investigations of the heat resistance of the spores of several Australian strains of *Clostridium botulinum*, it was found that various agar media gave divergent estimates of spores surviving heat treatment, even though each medium indicated similar numbers of viable spores in the unheated suspension. An attempt was made, therefore, to prepare a medium which would be reliable for the detection of spores surviving heat treatment. It has now been shown that the addition of small amounts of starch to media increases the number of colonies which develop from an inoculum of heated spores. Several types of natural starches produce similar effects in different infusion media suitable for the growth of *Cl. botulinum*. The influence of different concentrations of soluble starch added to pork infusion thioglycollate agar[1] is shown in the accompanying graph.



Cl. botulinum SPORES HEATED AT 100° C. IN *M*/15 PHOSPHATE *p*H 7·0. STRAIN *L4* (TYPE *A*). COUNTS MADE AFTER 21 DAYS AT 25° C. CURVE 1: SPORES UNHEATED; CURVE 2: SPORES HEATED FOR 60 MINUTES AT 100° C.

The estimates of unheated spores are virtually independent of the amount of starch in the medium, whereas the numbers of heated spores producing colonies are significantly increased by additions of starch up to approximately 0·1 per cent. The magnitude of the response to starch increases with the time of heating. The observed differences between media are not due to variations in the amount of heating as all comparisons are based on inoculations from the contents of one tube of heated spore suspension.

The action of starch is believed to be unique for the following reasons. No other polysaccharide tested shows any comparable effect. The activity of starch is unaffected by exhaustive extraction with 95 per cent ethanol, 85 per cent methanol, cold water, diethyl ether, or carbon tetrachloride, and the extracts are inactive. Repeated precipitation with alcohol causes no loss of activity. Maltose, glucose and glucose-1-phosphate are all without effect, and starch is rendered inactive by hydrolysis with mineral acid and also by crude α and β amylase preparations. Two samples of glycogen failed to show the properties of the starches, whereas a sample of synthetic starch prepared by Dr. C. S. Hanes was at least as active as the natural starches (see table). Fractions of potato starch prepared by the method of Schoch[2] have been tested, and the butanol-precipitated fraction found to be four

Cl. botulinum SPORES HEATED AT 100° C. in *M*/15 PHOSPHATE *p*H 7·0. Figures represent populations/ml. after incubation for 21 days at 25° C.

Medium	Strain *L4* (Type *A*) 0 min.	Strain *L4* (Type *A*) 60 min.	Strain *L12* (Type *B*) 0 min.	Strain *L12* (Type *B*) 120 min.
Pork infusion thioglycollate agar *p*H 7·3	12,000	20	21,000	15
+ 0·01% soluble starch	15,000	49	20,000	73
+ 0·1% soluble starch	14,000	104	22,000	200
+ 0·01% synthetic starch	12,000	52	22,000	80
+ 0·1% synthetic starch	18,000	100	19,000	200
	Strain *L4* (Type *A*) 0 min.	Strain *L4* (Type *A*) 60 min.	Strain *Q7* (Type *A*) 0 min.	Strain *Q7* (Type *A*) 120 min.
Pork infusion thioglycollate agar *p*H 7·1	25,000	1	60,000	0
+ 0·1% dog liver glycogen	24,000	8	60,000	5
+ 0·1% oyster glycogen	29,000	4	60,000	1
+ 0·1% soluble starch	23,000	76	56,000	50

to five times as active as the parent starch. It is likely, therefore, that the activity of natural starches resides primarily in the amylose rather than the amylo-pectin fraction.

Although no reason can be advanced for the observed effect of starch in increasing the numbers of spores 'surviving' heat treatment, the phenomenon has been found to apply under a wide range of conditions. For spores heated in phosphate buffer, or in vegetable infusions, the beneficial effects of additions of starch have been observed in media at various *p*H levels, at various temperatures of incubation, and in agar, gelatine and liquid preparations. The liquid cooked meat medium generally advocated for the detection of heated *Cl. botulinum* spores frequently fails to detect survivors, whereas as many as a hundred spores develop after a similar inoculum is transferred to a suitable solid medium containing starch.

Significant responses to the addition of starch have been obtained with heated spores of all strains tested. These include thirteen strains of *Cl. botulinum* (nine Australian, four American), eight other species of *Clostridium*, and ten strains of *Bacillus*. With the *Bacillus* strains, all of which were isolated from spoiled canned foods, the magnitude of the response to the addition of starch varies widely between strains and between media.

The results of these experiments will be published in detail elsewhere.

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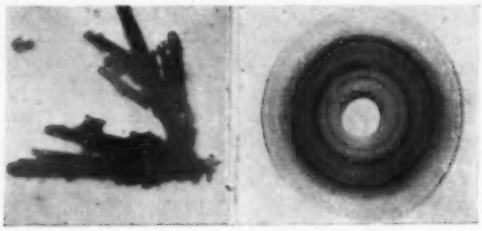
Chemistry of Leucaemia

THE chemical approach to leucæmia has centred mainly on the examination of urines from leucæmic patients. For a long time, scarcely any significant differences between normal and leucæmic urines were found[1]. This stagnation has recently been broken by the work of Turner, Miller and their associates[2], who have shown that human leucæmic urines contain substances which, when injected into guinea pigs, induce leucæmic infiltrations in many organs. The active products were extracted with chloroform. Other substances, chemically unrelated to those investigated by Turner, Miller *et al.* but with the same action on guinea pigs, have been investigated by Parsons[3]. There is no evidence that any one of the compounds studied causes human leucæmia, but the results of Turner and Miller focus interest on the chemical investigation of leucæmic urines as a source of active compounds or of specific metabolites. A preliminary report of further researches in this direction is given in this communication.

Three sharply characterized, apparently new compounds have been isolated from leucæmic urines: (1) a crystalline purple pigment, (2) a yellow pigment, and (3) a colourless, crystalline substance, m.p. 176–177°.

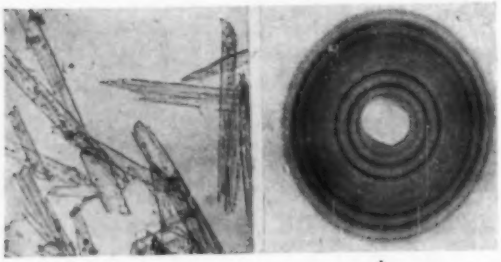
The purple pigment (1) can be extracted from alkaline solution with ether and removed from the etherial solution by a mixture of water, methanol and potassium hydroxide. If the alkaline solution is diluted with water the pigment can again be transferred to ether. It has been possible to characterize this substance by its X-ray powder diagram, but the quantity isolated was not sufficient for microanalyses (Fig. 1, *a* and *b*). The purple pigment is always present in leucæmic urines. Normal urine seems to contain the same or a similar compound in considerably smaller amounts.

The yellow pigment (2) is found in the benzoic acid fractions. It is characterized by two reactions: (*a*) the yellow solution of the pigment in ether, when treated with talc and shaken with dilute sodium hydroxide, gives a bright red sodium salt which is soluble in water; (*b*) the pigment can be adsorbed on aluminium oxide from its solution in ether or methanol. It forms a pink compound which can be eluted with dilute alkali giving a red alkali salt. It cannot be eluted with organic solvents. The pigment crystallizes easily at first, but loses its readiness for crystallization on storing or on treating with organic solvents in diffuse daylight.



a *b*

Fig. 1. PURPLE PIGMENT FROM URINE OF LEUCÆMIC PATIENTS: (*a*) PHOTOMICROGRAPH OF CRYSTALS; (*b*) X-RAY POWDER DIAGRAM, CYLINDRICAL CAMERA 3 CM. RADIUS (Cu *Kα*).



a *b*

Fig. 2. SUBSTANCE, M.P. 176–177° C., FROM URINE OF LEUCÆMIC PATIENTS: (*a*) PHOTOMICROGRAPH OF CRYSTALS; (*b*) X-RAY POWDER DIAGRAM, CYLINDRICAL CAMERA 3 CM. RADIUS (Cu *Kα*).

The substance has been found in one case of myelogenous leucæmia and in one case of lymphatic leucæmia. It is not present in normal urine.

The substance (3) m.p. 176–177° crystallizes in colourless, transparent needles and plates (Fig. 2*a*). It contains no sulphur and no halogen. Molecular weight determinations and analyses suggest the formula $C_{13}H_{14}N_2O_4$. It is characterized by its behaviour with Millon's reagent. When boiled with this reagent it slowly develops an intense red colour, which does not fade on standing for several weeks. It contains no methoxyl group. There is no reaction with ferric chloride or with sulphuric acid and formaldehyde; the urorosein reaction and the diazo reaction were also negative.

The substance was isolated from three samples of urine from patients with myelogenous leucæmia. Lack of material prevented the corresponding investigation of lymphatic leucæmia. So far the substance has not been found in normal urine. Its X-ray powder diagram is reproduced in Fig. 2*b*.

The chemical and physiological investigation of these compounds will be continued.

The X-ray powder diagrams were taken by Dr. M. Perutz, for whose help and collaboration we wish to express our thanks.

One of us (E. F.) is indebted to the Agricultural Research Council for financial support, the other to the Lady Tata Memorial Trust for a part-time research and expenses grant.

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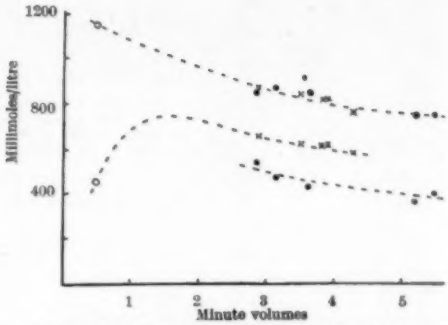
Forced Diuresis during Hydropenia

IN a paper which has recently been published, McCance[1] described the effects of administering hypertonic salt by mouth and intravenously to a dehydrated person. Volumes of urine up to 7–8 c.c./min. were passed, and this urine had a much lower osmotic pressure than the urine passed by the same person before the salt was given. The concentration of sodium chloride in the urine, however, appeared to be at or near the maximum concentration of which the kidney was capable, and it was suggested that the reabsorption of water in the distal tubules was being limited by the concentration of sodium chloride reached within them, a maximum value being attained when the osmotic pressure was still below the level at which it would become the limiting factor. It has now been shown that this conclusion was incorrect, and that it is the total osmotic pressure which is the limiting factor all the time, but that its limiting or maximal value is related to the minute volume, and falls as the latter rises. The evidence was obtained by such experiments as the following.



VARIATIONS IN THE TOTAL OSMOTIC PRESSURE OF THE URINE AND IN THE CONCENTRATION OF SALT WHICH ACCOMPANY A DIURESIS DURING HYDROPENIA.

○, Control data obtained after 16 hr. without water.
×, Data obtained after giving salt.
●, „ „ „ „ „ and cane sugar.
Curve I, total osmotic pressure; II, chlorides × 2 before injecting cane sugar; III, chlorides × 2 after injecting cane sugar.

After an overnight fast, the subject, a man aged twenty-six, weighing 82 kgm., took a dry breakfast and swallowed in the course of the morning 30 gm. sodium chloride dissolved in the minimum quantity of water. Between 12.30 and 1 p.m. he was given 12·5 gm. sodium chloride intravenously as a 5 per cent solution. This was followed by the expected diuresis, which gradually subsided over the next two hours. Five specimens of urine were collected at 20–40-minute intervals, and the relationship between the minute volume and the total osmotic pressure and the concentration of chloride are shown in the accompanying graph. The data for a day of dehydration without ingestion or injection of sodium chloride are also given (Curves I and II). At 3 p.m., 50 gm. of cane sugar were given intravenously as a 25 per cent solution. A further diuresis ensued and five further specimens of urine were collected between 3·27 p.m. and 5·2 p.m. as the diuresis decreased. The osmotic pressure and salt concentrations of these urines will also be found in the graph (Curves I and III). It is evident that the points relating the total osmotic pressure to the minute volume fall along the same line, whereas the concentration of chloride was very much depressed by giving the cane sugar. It is clear, therefore, that the attainment of a maximal concentration of sodium chloride in the distal tubules cannot be invoked to explain the diuresis, and it is suggested that it is the rate at which osmotically active material is delivered to the distal tubules which determines the minute volume.

Work is now in progress to determine whether this is true whatever the substance provoking the diuresis, and whether the fall in the total osmotic pressure of the urine which accompanies a forced diuresis during dehydration can be accounted for quantitatively by the fact that there is a limit to the amount of osmotic work which the kidney can perform per minute.

We are grateful to R. D. Keynes and P. D. S. Thomas for acting as subjects in these experiments.

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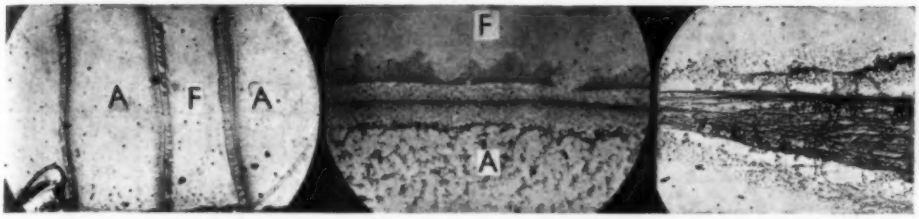
Structure of Salivary Gland Chromosomes

Kodani, Calvin and Goldschmidt[1] and Kodani[2,3] published a series of papers in which they describe the action of various sodium hydroxide and urea solutions on salivary gland chromosomes. The first steps on the reaction are the breaking up of bands into discrete granules, followed by condensation of carmine-stainable and Feulgen-positive substances into four longitudinal strings in each pair of homologous salivary gland chromosomes. After that there appear at right angles around these longitudinal strings stainable hairs resembling lampbrush chromosomes. The fact that condensation of stainable granules results in two longitudinal strings for each chromosome is used among others as evidence showing that these two strings have a primary existence in the normal untreated salivary gland chromosome.

By dissolving sodium thymonucleate in egg albumen, a solution is obtained which may be deposited on a slide either as a uniform continuous film or in lines, drops, etc. These when dried and treated with the alkali urea solutions, fixed and stained in acetocarmine or Feulgen stain, show that stainable granules migrate while the unstainable parts disappear. The migration of stainable granules depends partly on the direction of penetration of alkali urea solution. When on a dry film of sodium thymonucleate dissolved in egg albumen a line is drawn with alkali urea solution, that is, when the direction of penetration is partly controlled, the stainable granules migrate towards the centre of the line of alkali, in rows of equal length, resembling the 'lampbrush' structure obtained by Kodani. At their ends the rows are connected by a thicker single or double condensation line of stainable granules.



1. A DRIED FILM (*F*) OF SODIUM THYMONUCLEATE DISSOLVED IN EGG ALBUMEN ON WHICH LINES OF ALKALI UREA SOLUTION (*A*) WERE DRAWN. ARTEFACTS RESEMBLING LAMPBRUSH STRUCTURES ARE FORMED. ACETO-CARMINE STAIN.

2. THREE LINES OF CONDENSATION OF STAINABLE GRANULES FORMED ON THE EDGE OF A DROP (*A*) OF ALKALI UREA SOLUTION DEPOSITED ON A DRY FILM (*F*) OF SODIUM THYMONUCLEATE DISSOLVED IN EGG ALBUMEN. ACETO-CARMINE.

3. MIGRATION OF STAINABLE GRANULES AND FORMATION OF CONDENSATION LINE. A BUNDLE OF FIBRES COLLECTED FROM THE SURFACE OF SODIUM THYMONUCLEATE DISSOLVED IN EGG ALBUMEN TREATED WITH ALKALI UREA SOLUTION. ACETOCARMINE.

When a drop of alkali urea is deposited on a dry film of sodium thymonucleate dissolved in egg albumen, one or several such condensation lines may be formed.

The solution of sodium thymonucleate in egg albumen is capable of forming an organized layer on the surface. This layer when removed on a glass rod, like a folded umbrella, is seen even without staining to consist of wavy fibres. These fibres treated with alkali urea solutions show the same behaviour of the stainable granules as is described above; they emigrate from the fibres into the surrounding alkali urea solution. The migration is in lines perpendicular to the long axis of the fibres and at a certain distance from the fibre a condensation line is formed parallel to it.

The above experiments on the migration of stainable granules seem to indicate that the appearance of longitudinal strings of condensation in salivary gland chromosome after treatment with alkali urea could not, without reservation, be used as an evidence showing that these two condensation strings originally existed in the salivary gland chromosomes.

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Interaction Between Regenerating Limbs

DATA obtained elsewhere[1] appeared to show evidence of competitive interaction between a pair of regenerating Crustacean limbs: the effect was not statistically significant, however. Specific experiments to test this have also failed to yield a significant result. In forty individuals of *Asellus aquaticus* (L.) both limbs of the seventh and one of the eighth thoracic pair (right and left in equal numbers) were amputated at the autotomy plane. The regenerating seventh pair were measured when first visible externally, that is, after regeneration for one instar. The limb on the same side as the regenerating limb of the eighth pair showed a mean *excess* of 2·6 per cent in length over its partner, but with a probable error of ± 1·2 per cent. The effect is little greater than might be obtained by chance: in a random sample of forty individuals, with only the two limbs of the seventh pair regenerating, the left limb showed a mean excess of 1·7 ± 1·1 per cent over the right (while in a previous sample[2] an excess of the right over the left had seemed probable).

Paulain[3] also observed an insignificant competitive effect between regenerating limbs of Arthropods: the data of von Ubisch[4] showing mutual stimulation between such limbs do not appear to have been tested statistically. Interaction would seem to be, at the most, slight, and variable in character. Recent work[5,6,4] indicates that interaction between a regenerating and a non-regenerating limb is equally slight.

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A New Electronic Band-System of BaCl

WE have recently had occasion to photograph the emission spectra of the flames from various pyrotechnic compositions containing barium and chlorine compounds. The well-known green and ultra-violet band-systems of BaCl are, of course, strongly developed in these sources, but in addition, a number of bands in the region 7800–9500 A. are present on our spectrograms. These bands do not appear to have been recorded hitherto: they constitute what is evidently a new system of BaCl.

The spectrograms were taken in a first order of a 2·4 m. grating in an Eagle mounting (linear dispersion about 7·25 A./mm.): they show a number of rather close sequences of apparently double-headed bands degraded to longer wave-lengths. The violet edges of the two strongest sequences are at 8420·8 and 9098·0 A. About fifty-five bands have been arranged into a Deslandres vibrational scheme with the 8421 band as 0,0 band, while some twenty-five bands have been assigned to an array involving the 9098 band as 0,0 band. The data for the less refrangible heads are summarized in the following table: the second heads lie at about 4·1 cm.$^{-1}$ to the violet.

	ν_0		ω_e	$x_e\omega_e$
b	11880·0		255·25	0·83
a	10995·3		256·35	0·73
$X^1\Sigma$	0	(*b*)	279·4	0·765
		(*a*)	279·5	0·755

The above values of ω_e'' and of $x_e''\omega_e''$ are in satisfactory agreement with those for the ground-state of BaCl determined by Parker[1] from an analysis of the green system, namely, 278·4, 280·5 and 0·80 cm.$^{-1}$. The closeness of the bands within a given sequence makes it difficult to observe the vibrational isotope effect due to $Ba^{36}Cl$, $Ba^{37}Cl$, but for several favourably placed bands, notably the earlier members of the more refrangible 0,1 sequence, heads due to the heavier isotopic molecule have been identified with some certainty.

The evidence that the carrier of the new bands is BaCl is therefore very strong. Perhaps the most likely interpretation of the results is that the transition involved is $^3\Pi \rightarrow X^1\Sigma$, the doublet spacing of the upper state being about 885 cm.$^{-1}$. It is hoped to settle this point at a later date by extending the observations to longer wave-lengths.

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Ammonia Spectrum in the 1 cm. Wave-length Region

IN 1933 Cleeton and Williams[1] observed a broad absorption band in ammonia at atmospheric pressure in the region of 1 cm. wave-length; this is attributed to the 'inversion' of the pyramidal ammonia molecule which occurs when the nitrogen atom swings through the plane of the three hydrogen atoms. We have re-examined this phenomenon using a new technique, and have found that, as the pressure is reduced from 600 mm. mercury to 0·2 mm., so that the frequency of the collisions becomes small compared with the frequency of the radiation, an elaborate system of absorption lines appears.

The absorption coefficient was determined at high pressure by measuring the decrease in the power transmitted through a length of wave-guide into which the gas could be introduced. The results were in substantial agreement with those of Cleeton and Williams. At pressures below 10 mm. the absorption coefficient was derived from observations of the damping caused in a resonant cavity by admission of the gas; in this way absorptions as small as 2×10^{-4} per cm., which otherwise would require path-lengths of several hundred metres, could be detected.

The accompanying reproduction shows the spectrum observed at a pressure of 1·2 mm. mercury; owing to the low collision frequency numerous lines may be distinguished, their breadth being about 0·001 cm.$^{-1}$. By further reducing the pressure to 0·2 mm., more of these lines have been resolved.

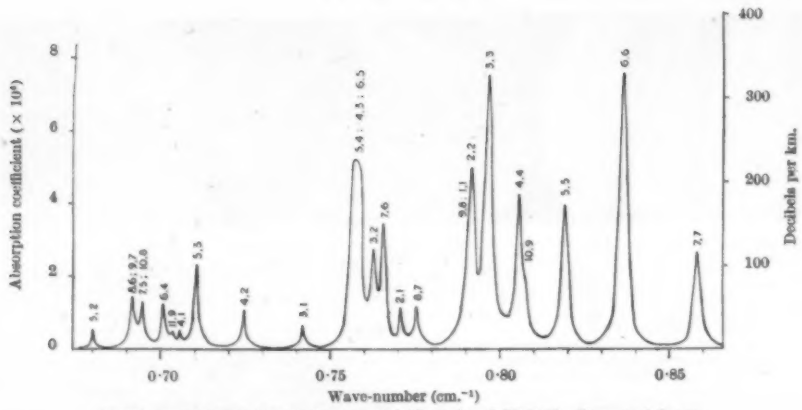
The extensive fine structure shown is due to the centrifugal distortion of the molecules in the various rotational levels; Hsi-yin Sheng, Barker and Dennison[2], using a potential energy curve proposed by Manning[3], have derived a formula for the fine structure of the inversion frequency of the form

$$\nu = \nu_0 - A(J^3 + J) + BK^2,$$

J and K being the rotational quantum numbers. The frequencies of the lines observed by us are accurately represented by a formula of the same type with the addition of a second-order term from the expansion of an exponential, namely,

$$\nu = 0{\cdot}7940 - 0{\cdot}0050_5(J^3 + J) + 0{\cdot}0070_4 K^2 + 0{\cdot}63\{-0{\cdot}0050(J^3 + J) + 0{\cdot}0070\,K^2\}^2 \text{ cm.}^{-1} \text{ (vacuo)}.$$

Eighteen lines have been examined at a pressure of 0·5 mm. Their intensities agree to within 5 per cent with those calculated from the statistical weights and transition probabilities, thus confirming the



ABSORPTION SPECTRUM OF AMMONIA FROM 0·67 CM.$^{-1}$ TO 0·87 CM.$^{-1}$. Pressure 1·2 mm. mercury. Values of J and K are given above the lines.

identification of the various lines with the appropriate rotational levels.

Two points of interest emerge:

(1) The form of the absorption curves over the wide range of pressure examined indicates that the line breadth is directly proportional to the pressure. This confirms that the broadening of the lines is due entirely to collisions. The actual breadth of the lines at 0·5 mm. pressure, however, requires ten to twenty times more collisions per second than we should expect according to the ordinary kinetic theory. As the normal value for the diameter of the ammonia molecules is about 3 A., this corresponds to an effective diameter of 9–14 A. In other words, a close approach, insufficient for any notable transfer of momentum such as occurs in collisions of the type considered in the kinetic theory, suffices to broaden the lines in question. Since the ammonia dipole produces at 10 A. a field of several hundred thousand volts per cm., which would cause a Stark splitting of the energy-levels of the order of 1 cm.$^{-1}$, it is not very surprising that an approach to this distance suffices to broaden the absorption line even though the 'collision' actually lasts only about 5×10^{-12} sec. That this interpretation is correct is borne out by the fact that the broadening of the various lines varies uniformly with their J and K numbers.

(2) The discrepancy between our observed frequencies and those calculated by Hsi-yin Sheng, Barker and Dennison based on Manning's expression for the potential energy seems to indicate that the shape of the potential energy curve requires modification. It may perhaps prove possible from our measurements to derive a more exact expression for the variation of the forces between the atoms with the distance.

B. BLEANEY.
R. P. PENROSE.

Clarendon Laboratory,
Oxford.
Feb. 12.

[1] Cleeton and Williams, *Phys. Rev.*, **45**, 234 (1934).
[2] Hsi-yin Sheng, Barker and Dennison, *Phys. Rev.*, **60**, 786 (1941).
[3] Manning, *J. Chem. Phys.*, **3**, 136 (1935).

Oxidation and Reduction in Chemistry

MAY I, in regard to my scheme for the mechanism of aromatic nitration[1], explain that I do not conceive the components within the bracketed complex as bound merely by van der Waals' forces, but in an intimacy which is dependent both on their nature and on the conditions to which they are exposed. Just as Hughes and Ingold have postulated a state "intermediate between the ionic and covalent extremes"[2], so I postulate one intermediate between radical and covalent extremes. While, therefore, I do not consider the criticisms of Ingold and his collaborators[3] applicable to my scheme, nevertheless in formulating it I had in mind the fact that instances are available in the literature indicative of radical formation as an accompaniment of the nitration process. Thus Auwers and Markowits showed that 2 : 6-dialkyl and dialoxyphenols are largely converted into the corresponding diphenoquinones[4], and the preponderating formation of resinous products in the nitration of symmetrical xylenol is also on record[5]. The formation of tetramethylbenzidine by heating dimethylaniline with sulphuric acid[6] may similarly be cited in regard to the sulphonation process.

Separation of the components of the complex $[Ar\cdots NO_2]$ will be favoured as in the above instances by electron donating substituents in the aryl nucleus, by the resonance of $\cdot NO_2$, and by accession of energy. Since, therefore, NO_2 is well known either to become polymerized to N_2O_4 or to break down to NO, we may expect this latter occurrence also to supervene in the complex if separation of the two components is adequate, yielding NO and ArO. The only other attempt at explanation of the hydroxylation which accompanies nitration is an unconvincing analogy drawn by Bennett between the behaviour of cationic NO_2 and nitrite anion[7].

I ought perhaps to say I believe all substitution, nuclear or side-chain, of aromatic amino or hydroxylic derivatives to be initiated by electronic exchange with the nitrogen or oxygen atom, thus:

$$\xrightarrow{Br\ +\ H_2} Ar.NH_2 + Br_2 \rightarrow [Ar\dot{N}\cdot\ \cdots Br] \rightleftarrows ArNHBr + H\cdot$$

Side-chain substitution is only completed if adequate means are available for removal of proton. Failing this, or on treatment of the side-chain substitution product with proton, elimination of a proton from the nucleus occurs as a result of transmission of the radical condition to nuclear *o*- or *p*-positions, where substitution then occurs. The benzidine reaction is a particular instance of this kind, so that while I concur in Dewar's rejection[8] of the unbroken N—N bond, the essential feature of Robinson's view of the mechanism of the benzidine reaction[9], I also feel that even if, as he suggests, the complex $[ArNH_2.\overset{+}{N}HAr]$ were formed, it would at once, in accordance with the $\xrightarrow{H_2}$ above scheme, yield $[Ar\dot{N}\cdot\ \cdot NHAr]$, as Jones and Kenner originally postulated[10].

Finally, I would take this opportunity of pointing out that the paragraph in my recent article in regard to the reaction of nitro compounds with hydroxyl or other ions requires modification, since the experimental evidence, of which the earliest appears to be that of Hepp[11], indicates that oxidation occurs after, rather than before, their interaction. In accordance, however, with the general trend of the article, we find that yellow mercuric oxide undergoes reduction when it is treated with nitrobenzene and caustic potash under Wohl's conditions[12]. Further, all the indications are that the alkylation of nitro-compounds and quinones by lead tetracetate[13] immediately is better regarded from this point of view than from one[14] involving a radical.

J. KENNER.

College of Technology,
Manchester, 1.
Jan. 8.

[1] *Nature*, **156**, 369 (1945).
[2] *J. Chem. Soc.*, 608 (1941).
[3] *Nature*, **156**, 688 (1945).
[4] *Ber.*, **38**, 226 (1905).
[5] Rowe and others, *J. Soc. Chem. Ind.*, **49**, 469 T (1930).
[6] Michler and Pattinson, *Ber.*, **14**, 2161 (1881).
[7] *J. Chem. Soc.*, 378 (1945).
[8] *Nature*, **156**, 784 (1945).
[9] *J. Chem. Soc.*, 220 (1941).
[10] *J. Chem. Soc.*, 1848 (1931); 711 (1932).
[11] *Annalen*, **215**, 344 (1882).
[12] *Ber.*, **32**, 3468 (1889).
[13] Fieser and others, *J. Amer. Chem. Soc.*, **63**, 577, 583, 2043, 2052, 2060 (1942); **63**, 15 (1943).
[14] Hey, Ann. Rep. Chem. Soc., 1944, 191.

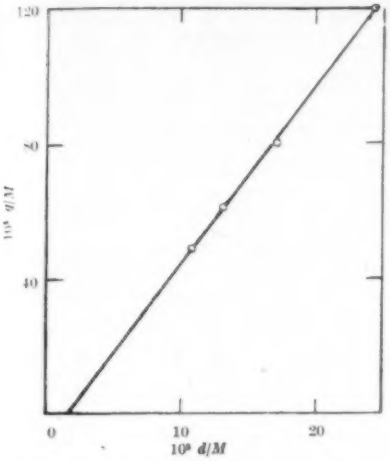
Validity of Gurwitsch's Rule

A RECENT examination of the sorption isothermals of a number of organic liquids on silica gels[1] shows that the well-known rule of Gurwitsch[2] is not always obeyed, that is, the volumes adsorbed at saturation are not constant. For one gel, the graph of q/M (the number of moles adsorbed at saturation) against d/M (the reciprocal of the molar volume) gave a linear plot which did not pass through the origin but followed the relation

$$q/M = 0{\cdot}25\ d/M - 0{\cdot}0007.$$

Thus, when $M/d = 357$, q/M is zero, so that substances having a molar volume greater than this should not be adsorbed. Unfortunately, although other workers have cast doubt on the validity of the rule, their data have not been sufficiently extensive for testing a relation of this type.

In a recent investigation of adsorption in relation to constitution, on silica gel, Gyani and Ganguly[3] report that as the molecular weight increases, the amounts of various alcohols adsorbed at saturation decrease. Their figures for methyl, ethyl, *n*-propyl and *n*-butyl alcohols,



when plotted as q/M against d/M, fall very closely on the straight line

$$q/M = 0{\cdot}528\ d/M - 0{\cdot}001$$

shown in the accompanying graph.

Broad and Foster[1] pointed out that relations of this type could be derived theoretically for systems containing tapering capillaries of molecular magnitude, since the volume cut off by an adsorbed molecule which blocks a pore is proportional to the molar volume. Independent confirmation of this relation by other workers is therefore of special interest, and it is to be hoped that future investigators who find deviations from Gurwitsch's rule will extend their observations over a wide enough range to test equations of this type.

A. G. Foster.

Chemistry Department,
Royal Holloway College,
University of London,
Englefield Green, Surrey.
Oct. 26.

[1] Broad, D. W., and Foster, A. G., *J. Chem. Soc.*, 366 (1945).
[2] *J. Russ. Phys. Chem. Soc.*, **47**, 805 (1915).
[3] *J. Phys. Chem.*, **49**, 216 (1945).

Resonance Energies of Acridine and Phenazine

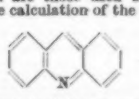
In the course of an investigation of the heats of combustion of a number of acridine derivatives, the heats of combustion of acridine and phenazine have been determined. From these data the resonance energies of these important heterocyclic nuclei have been calculated for the first time.

Acridine was prepared (*a*) from 5-chloroacridine by dechlorination with hydrogen in the presence of Raney-nickel[1] and (*b*) by precipitation with ammonia from B.D.H. acridine hydrochloride. Both specimens, after repeated recrystallization from aqueous alcohol, gave the same heat of combustion. Phenazine was prepared by the method of Eckert and Steiner[2] and purified by distillation in superheated steam.

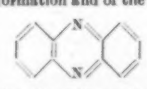
The heats of combustion of acridine and phenazine were found to be $8{,}797{\cdot}9 \pm 8{\cdot}9$ cal.$_{v}$/gm. and $8{,}103{\cdot}7 \pm 8{\cdot}0$ cal.$_{v}$/gm. respectively, referred to the value 6,324 cal.$_{is}$/gm. (in air) for benzoic acid. The molar heats of combustion at constant pressure are thus $1{,}577{\cdot}8 \pm 1{\cdot}6$ kgm.cal./mole and $1{,}460{\cdot}9 \pm 1{\cdot}4$ kgm.cal./mole.

Using the rule due to Walden[3] that $L/T_{abs.} = 13{\cdot}5$ approximately for most organic substances, the molar heats of fusion of acridine and phenazine are estimated as 5·2 and 6·0 kgm.cal., respectively. The boiling point of acridine is 346°[4] and that of phenazine, which had not previously been determined, was found to be 339°. Taking Trouton's constant as 22, the molar heats of vaporization are calculated to be 13·6 and 13·5 kgm.cal. respectively.

Thus the heats of combustion of acridine and phenazine in the vapour state are 1,596·6 kgm.cal./mole and 1,480·4 kgm.cal./mole respectively. The heats of formation of carbon dioxide and water and the heats of dissociation of nitrogen and hydrogen used in the calculation are those used by Pauling[5], as are the bond energies used in the calculation of the heats of formation and of the structures



and



It is found that the resonance energies of acridine and phenazine, referred to these structures, are 106 and 105 kgm.cal./mole respectively, which values do not differ by more than the experimental error from the value given by Pauling[5] for anthracene (105 kgm.cal./mole).

The similarity of the resonance energies of acridine and anthracene suggests that their structures are more closely similar than those of pyridine and benzene, or of quinoline and naphthalene. From considerations of the exaltation of refractivity, v. Auwers and Kraul[6] came to a similar conclusion.

	$\Sigma\delta_{Ref.}$	Resonance energy
Benzene	−0·2	39 kgm.cal./mole
Pyridine	+1·4	43
Naphthalene	+1·85	75
Quinoline	+1·0	69
Anthracene	+4·0	105
Acridine	+3·5	106

We are indebted to Dr. D. P. Mellor for his interest in the work.

Adrien Albert.
John B. Willis.

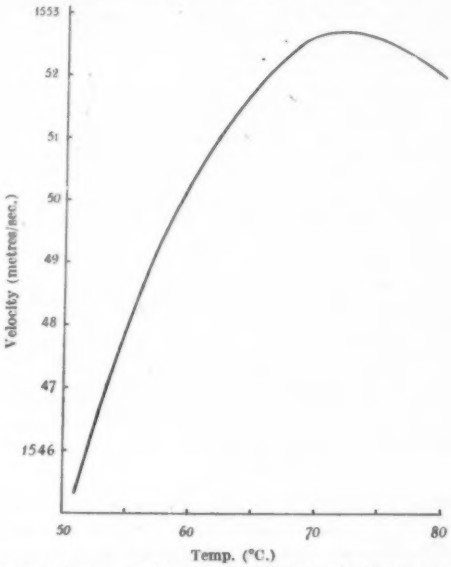
Depts. of Organic Chemistry and Chemistry,
University of Sydney. Oct. 16.

[1] Albert and Willis, *J. Chem. Soc.*, in the press.
[2] Eckert and Steiner, *Monats.*, **35**, 115 (1914).
[3] Walden, *Z. Elektrochem.*, **14**, 713 (1908).
[4] Decker, *Ber.*, **38**, 2502 (1905).
[5] Pauling, "The Nature of the Chemical Bond", *a*, 54, *b*, 136 (Cornell, 1940).
[6] v. Auwers and Kraul, *Z. Phys. Chem.*, **116**, 438 (1925).

Ultra-sonic Velocity in Water

In view of B. K. Singh's communication on the temperature effect on ultra-sonic velocity in water[1], it is felt that a brief account of some work done in these laboratories in 1940 may be of interest.

It was known that certain water-alcohol mixtures showed a point of maximum velocity, and it was required to investigate the phenomenon for a range of concentrations and to determine the relevant velocities to an accuracy of better than one part in 5,000. In view of the accuracy required, an absolute method was chosen in which the waves were produced by a quartz crystal driven by an oscillator the frequency of which was known to a few parts in a hundred thousand, and the distance containing an exact integral number of wave-lengths (about 5,000) measured to the same degree of accuracy.



During the course of this work it emerged that distilled water itself (resistivity 0·6 megohms per cm.[3] at 20° C.) possessed a maximum velocity and, as seen from the accompanying curve, this is 1552·7 metres per second and occurs at 72·7° C.

It is hoped at a later date to publish details of the experimental method and of an apparatus based on these results which permits the accurate measurement of short time-intervals in the range 2–300 micro-seconds. In the meantime, we should like to thank the Director of Scientific Research, Ministry of Supply, who has recently given permission for this work to be described and at whose instigation it was carried out.

P. L. F. Jones.
A. J. Gale.

Scophony, Ltd., Wells, Somerset.

[1] *Nature*, **156**, 569 (1945).

Rheology of Aqueous Felspar-Pastes

Felspar was not among the thirty substances, mostly minerals, of which the rheology was studied by Freundlich and Jones[1]; however, it exhibits noteworthy phenomena which are not peculiar to the sample examined in the present work.

This sample, which had been ground for use in the ceramic industry, was shown microscopically to consist largely of orthoclase and microcline; spectrographic analysis by Dr. L. H. Ahrens confirmed the essentially potassic nature of the material. The felspar fragments

had a plate-like form dependent on cleavage. The largest grain encountered had an upper surface of *c.* 12,950 μ^2 in area and was *c.* 35 μ thick, but there was a gradation of sizes down to individuals showing marked Brownian movement in aqueous suspension. The chief impurity was quartz as flattened chips; colourless and brown micas were occasional and calcium carbonate (probably of extraneous origin) was very rare.

Smooth pastes of appropriate water-content could be rolled between the hands to give balls which could be dried without marked loss of shape; when shaken, however, the moist globular masses collapsed, with a concomitant excretion of water, to form disks. This effect resembles passive dilatancy (Freundlich and Jones, *op. cit.*). The felspar plates were unorientated in the balls, though the superficial layer was parallel to the surface, but showed parallelism to the broad surfaces of the disks.

The pastes exhibited ordinary dilatancy in that they appeared to dry when disturbed; this effect was seen markedly in the collapsed discoidal masses, with their supernatant layers of excreted water mentioned above. For these masses, disturbance of the ordered structure would cause migration of surface water into the augmented pore-space.

However, slight thixotropy was indicated qualitatively; for example, suspended 'stalactites' of paste elongated rapidly on shaking and set when the vibration ceased. Winkler[2] stated that feeble thixotropy was shown by very fine-grained aqueous felspar; his description of quartz or felspar particles as "nahezu isometrischen" (p. 369), which he portrays diagrammatically on p. 370, does not, however, accord with my experience.

Felspar sediment, deposited from water, shrank in bulk when the containing tube was rolled, in a vertical position, between the hands (cf. Freundlich and Jones, *op. cit.*). Presumably, as these authors suggest, this shrinkage accompanies a transition towards a more regular particle orientation; this hypothesis could not be definitely established as the initial sediment already evinced a tendency to horizontal arrangement of the plate-like grains.

Cylinders of felspar paste, made by rolling between the hands, exhibited the 'backlash' effect (Macey[3]); it was necessary, however, to support the middle section to prevent sagging while the test-piece was alternately extended and compressed from the ends. It could be shown that the platey grains were disarranged by compression but followed the axis of the cylinder during tension; this latter orientation was also the initial one in the cylinders. Scott Blair[4] states that backlash is certainly associated with dilatancy.

Aqueous felspar is normally alkaline; indeed, the alkali-silicate produced by hydrolysis may be responsible for the slight coherence of the dried samples. Pastes made up with *c.* 2*N* hydrochloric acid again showed passive dilatancy and backlash, though deformation appeared rather easier. The large sedimentation volume in dilute hydrochloric acid (cf. von Buzágh[5], together with microscopical examination, indicated that the acidic felspar-system was flocculated.

Three separate batches of aqueous and of acidic felspar paste were made up to the correct consistency for rolling into mechanically stable globules; the consistency was judged purely by touch. The liquid contents were determined by drying, with the following results:

	1	2	3	
Aqueous pastes	23·3	22·8	22·9	per cent liquid by weight.
Acidic pastes	21·5	21·2	21·8	„ „ „

The figures for the acidic pastes are probably too low because of slight chemical reaction, for example, with the traces of calcium carbonate present; however, each set of results shows a remarkable uniformity.

In the foregoing experiments, particle orientation was determined microscopically in pyroxylin films stripped from smoothed surfaces of the dry coherent felspar masses; the technique was that previously used by me[6] for observing regularities of structure in ceramic 'bodies' but modified by rubbing down the preparations on glazed paper in the manner advocated by Weatherhead[7] for certain clays.

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Oct. 18.

[1] Freundlich, H., and Jones, A. D., *J. Phys. Chem.*, **40**, 1217 (1936).
[2] Winkler, H. G. F., *Kolloid-Beihefte*, **48**, 341 (1938).
[3] Macey, H. H., *Nature*, **147**, 146 (1941); see also *J. Sci. Instr.*, **18**, 159 (1941).
[4] Scott Blair, G. W., "A Survey of General and Applied Rheology" (London, 1944), see p. 60.
[5] Von Buzágh, A., "Colloid Systems", trans. by O. B. Darbishire (London, 1937), see p. 166.
[6] Williamson, W. O., *Trans. Brit. Ceram. Soc.*, **40**, 275 (1941).
[7] Weatherhead, A. V., *Mineral. Mag.*, **25**, 529 (1940).

The Forestry Commission

The weakness in the formation and constitution of the proposed Forestry Commission during its passage through the Houses of Parliament and after the Act was passed, as well as the consequences likely to arise therefrom, were clearly pointed out by *Nature* in 1919[1]. After more than twenty-five years experience it seems desirable to review again the manner of its constitution, the results that it has achieved, and to consider whether the country has gained the fullest possible advantage of so immense an expenditure*.

While the Bill was passing through the House of Lords in 1919, Lord Haldane pointed out "the danger of erecting an authority of the kind proposed, which would not be subordinate to any Minister"[2], and further "the lack of Commissioners possessed of sound technical training". When the Bill was before the House of Commons, it was said in *Nature*[1] that "The Commissioners will have powers to expend 3,500,000 pounds during the next ten years in afforestation. This sum of money is to be at their absolute disposal, and will be subject to no control by Parliament or any Minister responsible to Parliament", and later, "if the Bill represented a company prospectus involving the control and expenditure of three and a half million pounds, little of this amount would be subscribed in the absence of any assurance as to the satisfactory constitution of the directorate. This, however, is exactly what the Bill neglects to supply. There is nothing to ensure that any of the Commissioners—paid or unpaid—shall have any knowledge of forestry, so that . . . the Forestry Commissioners may similarly become purely political appointments". On the same date, in the House of Commons, "Sir Philip Magnus pointed out that the chief defect of the bill lay in its silence on the necessity of having on the central authority a preponderance of fully qualified scientific experts".

As a result, on the third reading of the Bill another Commissioner was added, with the condition that one Commissioner must have technical knowledge of forestry.

It is now proposed to embark upon an expenditure of another three and a half million pounds under the same administrative conditions, with the same absence of safeguards, with the minimum of scientific technical knowledge on the part of the Commissioners. There can be no doubt that the desperate condition of our forest woodlands, resulting from the War, demands immediate attention; but the proposal before Parliament has the same fundamental weakness to which *Nature* directed attention in 1919. The Commissioners are not to be appointed by virtue of their special technical knowledge or peculiar suitability for the task, or by the election of the shareholders (in this case the tax-payers). No inquiry has been instituted showing the manner of their previous stewardship, the only difference from the former state being that the Commission is to be placed under the Minister of Agriculture and Fisheries. Under the control of the Minister of Agriculture forestry may be swamped by the overwhelming preponderance of agricultural interests.

In practically every civilized country to-day, a sound forestry service is established producing admirable results. Freed from all political influences under one Minister with the help of the two national forest institutions and with the hearty goodwill of every landowner, our woodlands might be placed again in the same condition which we formerly enjoyed, but not otherwise.

Alexander L. Howard.

4 Stanhope Street, Euston Road,
London, N.W.1. Jan. 8.

[1] *Nature*, **103**, 441 (1919).
[2] *Nature*, **103**, 431 (1919).

* A review of the first twenty-five years of the Forestry Commission was published in *Nature* of March 17, 1945, p. 317, and a leading article on the subject appeared in the same issue, p. 311.—Editors.

Pigments of Fresh-water Triclads

With reference to a previous communication[1] in which it was suggested that the colours of *Polycelis nigra* and *Planaria lugubris* are due to different depositions of melanin in the skin, the fact that a red intermediate compound is formed in the oxidation of melanin from tyrosine is significant. Pink specimens often occur (8 per cent), and a large proportion of the *Polycelis cornuta* found at Cambridge are pink in colour.

J. L. Cloudsley-Thompson.

63 Lensfield Road, Cambridge. Nov. 11.

[1] Cloudsley-Thompson, J. L., *Nature*, **156**, 294 (1945).

Value of π

In 1853 there appeared, in a paper by W. Rutherford, the value of the constant π to 530 decimals, calculated by W. Shanks. This was eventually extended by Shanks to 607, and in 1873 to 707 decimals.

For more than seventy years this has been accepted as the value of π, apparently without any doubts having been expressed in print.

Recently, I decided to test numerically a series found by a colleague, R. W. Morris, namely,

$$\pi = 12 \tan^{-1}\frac{1}{4} + 4 \tan^{-1}\frac{1}{20} + 4 \tan^{-1}\frac{1}{1985}.$$

The value so obtained agrees with Shanks's value only to the 527th decimal place; from that point it seems that Shanks's value is incorrect.

The values from the 521st to 540th decimals are given below

86021 39501 60924 48077 (Shanks).
86021 39494 63952 24737 (D. F. F.).

It is of interest to note that the discrepancy occurs at about the point to which Shanks's first published value extends, that is, in the 530th decimal.

D. F. Ferguson.

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Importation of Scientific Apparatus and Material into Britain

On behalf of the Department of Scientific and Industrial Research, which is now responsible for the British Commonwealth Scientific Office, Washington, may I assure Dr. J. A. V. Butler that the difficulties he mentions in his letter published in *Nature* of February 23 about transactions with American suppliers are fully realized.

It is hoped that these are only temporary, but meanwhile the Department will be glad to give such help as is practicable, either to institutions or individuals, in obtaining apparatus or materials from the United States or elsewhere if cases of difficulty are brought to its notice.

O. F. Brown.

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FOOD AND WAR IN HONG KONG

THE period immediately prior to the War in the Far East and the forty-three months internment as a prisoner of the Japanese are of particular interest to one of the biologists present, who here gives an outline of the problems that had to be faced and of the improvisations necessary in so many cases to provide food for the people.

The Government of the Colony was instructed by the Imperial Government to prepare for a siege that might last approximately three months; great secrecy had to be maintained. The population, swelled by an influx of refugees from China, was of the order of 1,800,000, and there were present more destitutes and very poor than normally. The deaths from beriberi alone were a thousand monthly, and pellagra was steadily increasing in severity. The Medical Department could not be blamed for this situation; the malnutrition and appalling poverty were direct consequences of Japanese aggression in South China. Most of the food of the Colony is imported, and even at the best of times it would not be a very easy matter to prepare for a three months siege, but when the population is greatly swelled by destitutes the problem that faced the authorities could not be regarded casually. Such factors as the War in the West increasing steadily in tempo, the ever-decreasing supply of shipping, priority demands on essential commodities for Europe, the lack of knowledge of the week, month or even year that the Japanese would strike, and the firm and outspoken belief of many highly influential people that Japan would never fight, complicated the situation. Hong Kong had never before been faced with such a problem and did not immediately realize its implications, and it is not surprising, therefore, that mistakes were made and that delays occurred.

Most food is valueless without fuel. Firewood is by far the most important fuel of the Chinese, the daily Hong Kong consumption immediately prior to the War being five hundred tons, and so it was necessary to create an extensive firewood reserve. The amount entering the Colony by normal channels was rapidly decreasing, and it was found imperative for the Government to charter four steamers to import firewood. Two were placed on the Penang run (the wood having been brought in lighters from the Matang mangrove forests on the mainland), two were on the North Borneo run bringing mangrove wood from Sandakan and other ports. Very soon the Government firewood service was supplying not only fuel for the siege reserve but also almost the entire domestic needs of the Colony. Reserves of firewood were created in many places in the island.

It was a relatively easy matter to arrange for a balanced siege reserve of food for the non-Chinese population, and there is no need, therefore, to discuss that aspect of the problem.

Rice is the principal food of the Chinese, who are as particular about the quality of their rice as is the average English housewife of the bread she buys for the family. The Hong Kong Chinese prefer the narrow long-grain rice from French Indo-China; but in the year prior to the War much of the rice that had perforce to be supplied them was imported from Siam and Burma. Beans of several kinds form another item of their diet. The local Chinese are not particularly keen on the soybean as such—it takes too long to cook—but do enjoy curd, fresh or fermented, made from coagulated soybean 'milk', and at almost every meal use soybean sauce; they eat bean sprouts and, to a small extent, tinned salted black soybeans. Peanut oil is used for cooking, especially in the cooking of green vegetables, of which the Chinese are rightly so very fond. Fresh and salt fish are the only forms of animal protein available to the masses, though pork, chicken and duck are greatly esteemed by those who can afford them.

The problem that faced the authorities was to establish a siege reserve that would maintain the life of the populace for three months, not in the bad condition that the people would be in when the War started but at a higher level. The less the medical authorities were to be worried with malnutrition the more time and skill could they give to the treatment of casualties. The ideal aimed at was a correctly balanced diet, one that would improve the vigour and health of the people during the dreary months of siege. Of course, there were people who said that a rice reserve alone would suffice; so it might well have done should a plentiful supply of green vegetables also have been available; but only one fifth of the Colony's vegetable supply is grown locally, and with a blockade and probable occupation of the New Territories this fraction might be considerably reduced.

Rice being the basic food, a Government Rice Monopoly was created and run by a special department largely independent of the Food Control. Arrangements were made that controlled imports should be held for a period and the oldest rice in store released for sale; thus a very large reserve, regularly being turned over, could be maintained. As the Monopoly supplied rice destined for Shanghai as well as for the retail trade of the Colony, this arrangement proved possible. But no one had ever stored rice in Hong Kong for long periods; there existed not a single scientifically designed godown for such long storage of grain and, of course, storage facilities were quite inadequate. It was necessary to build godowns in various parts of the island, not only for rice but also for other foods, and they had to be built of materials available and to the best plans that Government architects could devise; but no insect control methods were evolved and the tremendous damage that rice and bean weevils, flour beetles and rice moths could do was not appreciated for some months.

A bean pool was created, not only for soybeans but also for other beans including the Tientsin bean, *Phaseolus aureus*, and the Red bean, *P. calcaratus*. The maintenance of this pool was complicated by the fact that these three beans were not available until October, and though further supplies might arrive from the north during the winter months all would have been derived from the same harvest and would have to be stored during the hot and humid summer months until the arrival of the next autumn's crop. Shanghai did not wish to buy old beans from North China and Manchuria via Hong Kong, and as the turnover aimed at greatly exceeded Hong Kong's peace-time requirements it provided a pretty problem.

The large yellow soybeans proved more resistant to the pea weevil than the smaller, thinner-skinned, green soybean and the Tientsin bean; but though they survived the weevil, many died on us. The Chinese are fond of bean sprouts, prepared both from

the soybean and from the Tientsin bean, but neither weevil-infected beans nor dead beans sprout.

Another pool took care of oil supplies, principally peanut oil, but coco-nut and small amounts of other vegetable oils passed through the pool. Care was taken to see that reserves of salt were adequate.

A siege ration based on rice, beans, oil and salt is a definite improvement on one of rice alone; but it was not considered sufficient. To meet vitamin requirements large amounts of thiamin chloride were purchased in the United States and sent to Hong Kong by air, nicotinic acid was ordered in England but did not arrive prior to hostilities and three hundred tons of red palm oil were imported from Malaya. Arrangements were made with the fishing fleets to bring in the livers of all the large sharks caught, and shark liver oil, rich in vitamins A and D, was extracted and stored in sealed tins. A simple technique was adopted for the extraction of a solution of vitamin C from pine needles—*P. Massoniana* is abundant on the island. Consideration was also given to the possibilities of creating reserves of soy sauce, salted and dried vegetables, dried seaweed and even dried grass, but they were turned down as either of little food value or impracticable. Inquiries were made in London regarding the possibility of starting a food yeast factory, and others in Honolulu regarding the possibility of growing brewer's yeast, for there were ample reserves of molasses and supplies of ammonia and superphosphate, but the War came before any large scheme could be put into operation, though trials were commenced.

Peanut meal, after the oil has been expressed, is pressed into cakes and sold almost exclusively in Hong Kong as fertilizer. This cake is unpalatable as human food, largely because the oils it contains rapidly go rancid, but the fresh meal, straight from the press, has not this objection. With the enthusiastic co-operation of a master baker and after about thirty trials, it was found possible to make a hard siege-ration biscuit from this meal and whole wheat flour. Each biscuit, which weighed half an ounce and cost half a cent, contained more than a man's daily requirements of available iron, two biscuits enough nicotinic acid to prevent pellagra and four enough thiamin chloride to prevent beriberi on a polished rice diet. Government approved of the biscuit, and a start was made in producing them at the rate of two tons a day; a larger scheme for making eight tons daily was not implemented due to hostilities. The biscuits contained only 2 per cent water, and they were packed in petrol tins which were then sealed. On the day before the Japanese attacked, a satisfactory biscuit was made which contained added calcium carbonate and shark liver oil. Everybody liked the biscuits—all nationalities and all ages from six months to over eighty years—for they were tested in three hospitals (including a maternity hospital) before the scheme was placed before the Defence Council.

Another project which was adopted was the creation of a salt fish reserve. Within a month of the idea being conceived the factory was in operation. The idea was to salt fish of selected kinds in enormous wooden tubs and to leave them, weighted with stones, submerged in the pickle that was formed. The tubs were mostly made on the site from teak, but some old ones of China fir were purchased, after the godowns had been built, and some were so large that the wall of a building had to be pulled down in order to allow the entry of the tubs. The objective was a thousand tons, and more than six hundred tons were safely stored away when the *blitz* commenced.

The Japanese attacked and in seventeen days the Colony was in their hands and with it a very tidy reserve of firewood, rice and other foodstuffs, not to speak of a great wealth of merchandise.

On January 21, 1942, the civilian internment camp at Stanley was opened and there new problems had to be faced and solved. Much of the siege reserve of thiamin chloride was smuggled into this camp (and into the military camps), more than two hundred tins of siege biscuits, some shark liver oil and a drum or two of red palm oil. A valiant Chinese prepared shark liver oil during the whole period of internment and sent it into the camps through the International Red Cross. Space does not permit a consideration of the food problems of the internment camp, which were as interesting as they were novel.

SCIENCE AND EDUCATION

A SUCCESSFUL second conference on "Science and Education" was held by the Leeds Branch of the Association of Scientific Workers on December 15 and was attended by more than eighty people, including delegates from twelve organisations. Prof. W. T. Astbury was in the chair.

Prof. J. D. Bernal, in opening the Conference, said that although the Government has appointed an influential sub-committee to investigate the training and use of scientific man-power on a national level, local meetings can nevertheless do valuable work by maintaining intelligent pressure on those responsible for seeing that the necessary steps are in fact taken. While he agrees with the policy which has previously been put forward by the Association of Scientific Workers, in his view, recent events now make a big increase both in the scale and the speed of attainment of these objectives essential. Thus the application of atomic energy can lift the level of human existence on to an entirely new plane; but this will only be realized if accompanied by vast improvements in other technical and intellectual fields and, in consequence, education in science for every citizen has now become a necessity.

In working out the problems of the atomic bomb project, a new organisational technique of mass attack on a problem with full integration of scientific, technical and social aspects has been evolved. Such a technique will have to be adopted by Britain for other problems if she is to maintain her position relative to other nations. The ultimate social saving from research is usually out of all proportion to its cost, but, in addition, it is now widely recognized that the immediate saving may also be well worth while, as when the organisers of greyhound-racing propose to spend on investigating dog hysteria about half the total sum spent on our pre-war medical research.

The limit on our researches in the near future is not likely to be a financial one, but will be a result of the limited supply of trained scientific workers available. It is not that we lack resources of intelligence: about eight per cent of the population seemed to have I.Q.s of 130 or higher and could therefore benefit from a university course. To make use of this intelligence will represent an eightfold increase in the past university population. The difficulties in the way of such an expansion will have to be overcome by new lines of approach. The supply of

teachers could be increased by drawing, perhaps part-time, on the fifty thousand industrial scientific workers not usually engaged in teaching. Senior students could also help with the more elementary teaching and perhaps provide a modified form of tutorial supervision.

The difficulties of space could also be overcome. Destroyed universities are being rebuilt all over Europe. In Riga, for example, students and staff are building their own university, and while this solution is scarcely necessary in Britain, unorthodox methods should not be excluded; thus, space in shadow factories and similar war buildings might be made available if it was pressed for hard enough. In Prof. Bernal's opinion, the universities should have no difficulty in getting the money necessary for their schemes provided the existing machinery for this purpose were used effectively. The University Grants Committee has assured universities that the Treasury would provide the funds if asked for them.

If this proposed expansion of the science faculties is thwarted by narrow-minded university authorities lest the balance of the universities be upset or their seclusion spoilt, then as once or twice before in our history, new universities will no doubt be founded elsewhere, and indeed in any event we must step up many of our technical colleges to the standard of the former Technische Hochschule in Germany.

In conclusion, Prof. Bernal said that the urgent need of Great Britain and the world for science is so great that it imposes on every man of science a definite duty to pass on his knowledge to others; and effective channels must be provided through which this can be done.

In throwing open the subject for discussion, Prof. Astbury said that he has been somewhat depressed by his own experiences with science discussion groups for adults and he considers it essential to introduce the subject to the populace while they are still young. He does not share Prof. Bernal's view that extra money is available to the universities for the asking, since at Leeds they receive only 60–80 per cent of their own estimated needs.

Mr. J. Maddison put in a plea for more importance to be attached to mechanical aids to teaching, including not only the film but also charts and improved text-books. He suggested the Association of Scientific Workers should press for the preparation of more and better teaching films. Mr. H. D. Dickinson stated that there is already a fringe of unsuitable students coming up with scholarships and he wonders whether the present methods do not sometimes select the most docile rather than the most able students; his experience with adult education has shown him that there is often a second flowering of intellectual ability later in life, and he suggested that any future system should include provision for such older students.

A number of speakers, including Mr. P. G. Espinasse and Dr. Guter, stressed the amount of a teacher's time which is wasted on non-teaching duties because of the present absence of adequately trained laboratory assistance. Dr. Guter pointed out that on Teeside all the part-time degree teaching is done by those engaged in local industry, but this has resulted in excessive demands being made on the volunteers. He suggested that a system of time off from their regular daily work might be arranged for such teachers during the time of the present emergency.

Mr. M. Kline considers it is in the primary schools that most citizens must learn of science; yet teaching conditions in them are unsatisfactory, so that science there has become an unreal thing of words and symbols, with blackboard work instead of experiments. Dr. A. J. P. Martin said it is depressing for men of science to encounter a complete lack of appreciation in many industrialists as to what science is all about, and it is to be hoped that a higher status for the subject in both primary and secondary schools will help to spread a realization that there is more in scientific method than the simple details of the individual sciences.

Prof. Bernal, replying to the points made by these and other speakers, said he fully appreciated the importance of a really good primary education and, in view of the grievous shortage of scientific apparatus, it is shocking to hear of war stocks being destroyed; nevertheless, a good teacher can do a great deal in improvising experiments with everyday objects, and teachers' organisations should press for more research work into actual teaching methods to be carried out. The proportion of assistants available in university laboratories might be only one fiftieth of that in good industrial laboratories; university teachers are in part to blame for putting up with these conditions so long and so docilely. He was encouraged by what he heard of the possibility of increasing the supply of teachers with part-time workers. This scheme has the advantage of providing the teachers just where they are most needed; but, clearly, a national scheme for part-time releases of government and industrial scientific workers for teaching is what is required. Warnings have been given that difficulty might be encountered in future in recruiting enough teachers of the required standard into the secondary schools, and Prof. Bernal regrets that the universities are still not to have the task of training all teachers. Finally, under the more positive policy towards industry which is being adopted by the present Government, there is a great need for every Government department to include a body of scientific workers engaged not only in technical but also in operational research, so that the methods of the Civil Service could be transformed into those appropriate for the new scientific age.

In concluding its business, the Conference, on the motion of Dr. A. H. Gordon, resolved to set up a small permanent committee representative of the organisations participating in the Conference to advise appropriate local bodies in Leeds on any aspect of local education and science. E. G. CARTER.

DISEASE AND TROPICAL INDUSTRY

THE report of the meeting of the Advisory Committee of the Ross Institute held in July last contains a valuable review by Dr. G. Macdonald of some of the diseases which interfere most severely with tropical industry. During the War, states Dr. Macdonald, the Army has learnt that, in the tropics, malaria is the most important cause both of incapacity and of the failure of whole projects. This is a lesson which tropical industry learnt years ago. New methods of tackling malaria have, however, been developed. The two main developments originated in pre-war civilian practice. These are the eradication of anopheline vectors rather than the attack upon malaria itself; and the proof that the control of the adult mosquito is an economical as well as an effective method, which can be applied to rural communities at a cost which even the most primitive communities can bear.

The eradication of *Anopheles gambiæ* from Brazil during the years 1919–42 (see *Nature*, **153**, 765; 1944) showed that eradication of the vector from large areas of country is possible. A second campaign of a similar kind is now being carried out in Egypt, where *A. gambiæ* caused devastating epidemics of malaria in 1942 and 1943. We do not know when *A. gambiæ* first invaded the Nile Valley, but by 1943 malaria carried by this species was causing total disorganisation of large areas, very large numbers of deaths and so much illness that food production and distribution were hampered and famine was the result. The men who eradicated *A. gambiæ* from Brazil are now attacking it over an area of three hundred miles of the Nile Valley and there is every prospect of a success as brilliant as that which they achieved in Brazil.

Dr. Macdonald pointed out that the success of these anti-mosquito campaigns has been possible because (1) re-invasion by the mosquito of the two areas concerned is difficult and can be prevented fairly easily, Brazil being guarded by the sea and Egypt by the desert; (2) the mosquito can be readily discovered in both its immature and mature stages; (3) there is a climatic off-season when the mosquito's breeding places are reduced in number, so that they can be more readily tackled; (4) the organisation employed effectively co-ordinates the work in the different areas and is otherwise very efficient; and (5) sufficient money, men and time are freely made available. Dr. Macdonald thinks that these successes might be repeated in other areas, especially in such island areas as Mauritius and the Seychelles, where the anopheline species involved is the same one. In other areas, where different anopheline species are concerned, such as Ceylon and the West Indies, Malaya and Freetown, Sierra Leone, the conditions of success may be different, but the possibilities of eradication should be seriously considered. Russell and his colleagues have shown that systematic spraying of rural areas twice a week with various solutions and emulsions of pyrethrum can change, in two or three years, highly malarious areas into virtually non-malarious ones, the cost being no more than 3½*d.* per head per annual season of twenty-two weeks. Little more than ½*d.* per head of this cost was spent upon imported products. Thus this method is within the means of the most poverty-stricken or primitive areas, provided that there is careful organisation and systematic application. This method does not, however, replace larval control where certain results are needed. D.D.T. will greatly lessen the labours involved in the control of the adult mosquito, but D.D.T. will not remove the greatest difficulty of malaria control, namely, adequate supervision. From the economic point of view, the use of D.D.T. as a larvicide is still in its experimental stage and it is not likely to be a great advance in the control of pool-breeding mosquitoes, such as those which are the chief vectors in Africa and Ceylon. On the other hand, D.D.T. can make it impossible for an aircraft to carry a live mosquito for a long journey, a fact which will help to minimize the transmission over large distances, not only of malaria-carrying mosquitoes, but also of those which transmit yellow fever.

Dr. Macdonald no doubt means it to be understood that D.D.T. can do this provided that its application to aircraft—and, indeed, to anything else—is efficiently and systematically carried out. His views may be compared with those expressed by the *Lancet* (311, Sept. 8; 1945) in its discussion of the Government's Report on Colonial Research (H.M. Stationery Office. Cmd. 6663. 6*d.*). The *Lancet* points out that C. B. Symes and A. B. Hadaway showed that, under suitable conditions, the mosquito population in houses can be almost completely annihilated by D.D.T. and that the number of larvæ in breeding grounds can be greatly diminished. It is, however, realized that the technical difficulties in the way of the effective and economical distribution of D.D.T. are very complex and that many years of team-work by chemists, engineers, entomologists and other experts will be needed before the value of D.D.T. for mosquito control can be correctly evaluated. Although, in addition, D.D.T. may prove to be a useful means of controlling other noxious arthropods, its indiscriminate use may also have serious effects upon arthropods which are useful to man in malarious areas. This kind of warning against the too-hasty use of D.D.T. for these purposes has been more than once expressed elsewhere. United States workers have, for example, pointed out that we do not yet know enough about the possible effects upon man of D.D.T. which has been sprayed upon crops for the control of insect pests. Nor do we know whether it is capable of exerting slow effects upon man and animals when it is incorporated in paints, varnishes and similar products. People who work with it and animals to which ointments containing it are applied may, moreover, under certain conditions be poisoned by it (cf. E. L. Taylor, *Lancet*, 320, Sept. 8; 1945). V. B. Wigglesworth (*Brit. Med. J.*, 517, April 14, 1945) has recorded a case of D.D.T. poisoning of an adult man, K. R. Hill and G. Robinson (*Nature*, 156, 780; 1945) a fatal case of poisoning of a child, and R. A. M. Case (*Brit. Med. J.*, 842, Dec. 15, 1945) also reports toxic effects and emphasizes the danger of D.D.T. in the presence of oil (see, however, W. G. Dangerfield *Brit. Med. J.*, 27, Jan. 6, 1946).

The Colonial Research Committee is also organising research upon the development of cinchona in East Africa, so that we may in the future be no longer dependent for the world's main supply of cinchona from Java, which was captured by the Japanese soon after her entry into the recent War. This capture, however, resulted in the development by the Allies of mepacrine (atebrin), which is now used as a prophylactic and curative anti-malarial drug and renders us independent of cinchona (see *Nature*, **155**, 15; 1945).

Discussing other anti-malarial measures, Dr. Macdonald said that highly organised destruction of adult mosquitoes by means of sprays applied with power syringes, and systematic treatment of all potential breeding places with hand-strewn Paris Green (that is, the methods used in the campaign in Brazil) completely effected rapid control of malaria for the purposes of the Eighth Army in Italy in 1944 within two days of the first occupation. The principles of the methods then used can, he suggested, be re-applied when we re-enter Malaya.

Dysentery is also one of the larger problems. The best means of preventing it is good sanitation, but this is not always possible, so that the remarkably successful abortive and curative effects of sulphanilylguanidine are invaluable. Like Sir Leonard Rogers and Sir John Megaw ("Tropical Medicine." London: J. and A. Churchill, 1944), Dr. Macdonald regards malnutrition as being "the bane of the tropics". It is good to know that the Colonial Research Committee is also organising an investigation of it. Dr. Macdonald also thinks that mite typhus (scrub typhus) may, as methods of cultivation of the land change,

become more important in the tropics in the future.

Subsequent speakers at this meeting added their experience in industry to support Dr. Macdonald's views. It is evident from these speeches that the industrialist is well aware of the industrial need for, and the value to industry of, modern methods of control of disease. Brig.-General F. D. Hammond, indeed, said that hitherto the main support for tropical hygiene had come from commercial undertakings rather than from Governments. Tropical hygiene should, he thought, take priority over everything else because, unless the inhabitants are healthy, it is no use talking about development. Dr. Macdonald, in his reply, pointed out that the Colonial Development and Welfare Act allowed for an expenditure of 120 million pounds during the next ten years, with a maximum expenditure of seventeen and a half millions in any one year. The Secretary for the Colonies had stated that part of this money would be spent upon the development of health and education, and it was laid down that not more than one million in any one year should be spent upon research and inquiry of all kinds. Only a proportion of this sum, therefore, would go to medical research. Mr. C. R. Harrison, however, revealed that in Mauritius, at any rate, a "very large proportion" of the money received from the Colonial Development Fund will be devoted to hygiene and particularly to the control of malaria. It is to be hoped that other areas will copy this fine example.

G. LAPAGE.

INTER-UNIVERSITY COUNCIL FOR HIGHER EDUCATION IN THE COLONIES

IN accordance with the recommendation of the Commission on Higher Education in the Colonies (see *Nature*, Sept. 22, 1945, p. 345), the Government invited the universities of the United Kingdom, the University of Ceylon, the Hebrew University, Jerusalem, and the Royal University of Malta, to nominate representatives to serve on a body to be known as the Inter-University Council for Higher Education in the Colonies. All these universities accepted the invitation and their representatives, together with the educational adviser to the Secretary of State for the Colonies, met for the first time in London, on March 8, when the Council was formally set up. The members of the Council are: Sir William Hamilton Fyfe, vice-chancellor and principal, University of Aberdeen; Prof. R. G. Baskett, professor of agricultural chemistry, University of Belfast; Dr. R. E. Priestley, vice-chancellor and principal, University of Birmingham; Mr. P. R. Morris, vice-chancellor, University of Bristol; Dr. J. A. Venn, president, Queens' College, Cambridge; Dr. W. Ivor Jennings, vice-chancellor, University of Ceylon; Dr. J. F. Duff, vice-chancellor, University of Durham; Prof. John Macmurray, professor of moral philosophy, University of Edinburgh; Prof. Noah Morris, regius professor of materia medica and therapeutics, University of Glasgow; Prof. Norman Bentwich, professor of international relations, Hebrew University, Jerusalem; Mr. B. Mouat Jones, vice-chancellor, University of Leeds; Prof. J. G. Wright, professor of veterinary surgery, University of Liverpool; Sir Alexander Carr-Saunders, director, London School of Economics and Political Science; Prof. Robert V. Galea, rector, Royal University of Malta; Prof. W. J. Pugh, deputy vice-chancellor and professor of geology, University of Manchester; Dr. W. T. S. Stallybrass, pro-vice-chancellor, University of Oxford; Prof. R. H. Stoughton, professor of horticulture, University of Reading; Sir James Irvine, vice-chancellor and principal, University of St. Andrews; Prof. L. E. S. Eastham, professor of zoology, University of Sheffield; Mr. Ifor L. Evans, principal, University College of Wales, Aberystwyth; Mr. C. W. M. Cox, educational adviser to the Secretary of State for the Colonies. The secretary of the Council is Mr. Walter Adams. Sir James Irvine was elected chairman and Sir Alexander Carr-Saunders vice-chairman.

The Council's objects are stated in its constitution and terms of reference to be (*a*) to strengthen co-operation between the universities of the United Kingdom and the existing universities in Colonial territories: (*b*) to foster the development of higher colleges in the Colonies and their advance to university status; and (*c*) to take such other action as will give effect to the principles recommended by the Commission as appropriate for the promotion of higher education, learning and research in the Colonies. It will also be noted that a full-time secretary has been appointed to serve the Council; he will also serve the Colonial University Grants Advisory Committee, which is being established as an advisory body to the Secretary of State, as recommended by the Commission. Two members of the new Council will also serve on the Grants Committee. It is also hoped that members of the Council will obtain first-hand experience of the development and needs of Colonial universities. It is hoped, too, that the Council will be ready to advise Colonial institutions of higher education on matters of academic policy, including questions relating to research work in such institutions. On questions of research it is assumed that the Council will maintain liaison with the Colonial Research Committee and other research bodies set up by the Secretary of State.

To welcome the Inter-University Council at its first meeting, Mr. G. H. Hall, Secretary of State for the Colonies, sent a message, in the course of which he said that the Government is pledged to quicken the social, economic and political progress of Colonial peoples and to guide them towards the ultimate goal of self-government. The success of this policy will depend on the emergence, in every Colonial territory, of increasing numbers of educated men and women with the technical training, the ability and the desire to serve their communities as leaders in every sphere of public life. The establishment of further universities in the Colonial territories can contribute greatly towards the achievement of this goal, and in furtherance of this task the Government has allocated £4,500,000 for higher education in the Colonies during the next decade. Mr. Hall also expressed the hope that although universities in Britain are facing grave difficulties in finding staff and in restoring themselves after the great efforts which they made in the War, they will be able to discover means of lending some of their own members to assist the development of the new university colleges, particularly in their early stages. He also referred to the jealous care with which universities guard their autonomy and freedom from governmental interference, and added that he was sure that in such freedom the Council could better discharge the great tasks it has undertaken.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Monday, March 18

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5.30 p.m.—Dr. G. C. L. Bertram: "Present Trends in Population Relative to Biological Resources, with special reference to the British Empire".

ASSOCIATION OF AUSTRIAN ENGINEERS, CHEMISTS AND SCIENTIFIC WORKERS IN GREAT BRITAIN (at the Austrian Centre, 69 Greencroft Gardens, London, N.W.6), at 7.15 p.m.—Dr. M. F. Perutz: "Crystallised Proteins".

Tuesday, March 19

ROYAL SOCIETY OF ARTS, DOMINIONS AND COLONIES SECTION (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. F. L. McDougall: "Australia and Post-War Reconstruction".

SOCIETY OF CHEMICAL INDUSTRY, AGRICULTURE GROUP (in the Physical Chemistry Lecture Theatre, Royal College of Science, Imperial Institute Road, London, S.W.7), at 2.30 p.m.—Dr. H. Martin: "Insecticides—Chemical Constitution and Toxicity".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Sir Lawrence Bragg, F.R.S.: "The Atomic Structure of Minerals".

EUGENICS SOCIETY (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Dr. C. P. Blacker: "Galton's Outlook on Religion".

SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield 1), at 6.30 p.m.—Mr. E. Roberts: "General Impressions of the U.S.S.R. and its Iron and Steel Industry".

Wednesday, March 20

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. A. S. C. Lawrence: "The Future of Scientific Films".

ROYAL INSTITUTE OF CHEMISTRY (joint meeting with the LONDON BRANCH OF THE INSTITUTE OF PHYSICS, at the Royal Institution, Albemarle Street, London, W.1), at 2.30 p.m.—Discussion on "Polar Molecules and Dielectric Problems" (to be opened by Dr. S. Whitehead, Mr. A. J. Maddock and Mr. N. J. L. Megson).

ROYAL METEOROLOGICAL SOCIETY (at 49 Cromwell Road, London, S.W.7), at 5 p.m.—Sir Charles W. B. Normand: "Energy in the Atmosphere" (G. J. Symons Memorial Lecture).

BRITISH INSTITUTION OF RADIO ENGINEERS (at the Institution of Structural Engineers, 11 Upper Belgrave Street, London, S.W.1), at 6.15 p.m.—Dr. R. L. Smith-Rose: "The Effects of Solar Eclipses on the Ionosphere".

THE POLYTECHNIC (in the Fyvie Hall, The Polytechnic, Regent Street, London, W.1), at 6.30 p.m.—Mr. Oliver Bell: "The Film To-day", 5: "The Film and Education".*

SOCIETY OF CHEMICAL INDUSTRY, FOOD GROUP (joint meeting of the MICROBIOLOGICAL AND NUTRITION PANELS, at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 6.30 p.m.—Dr. E. C. Barton-Wright: "Amino Acids and the Metabolism of the Cell".

SOCIETY OF CHEMICAL INDUSTRY, PLASTICS GROUP (at Gas Industry House, 1 Grosvenor Place, London, S.W.1), at 6.30 p.m.—A member of the Research Staff of British Industrial Plastics, Ltd.: "Amino-plastic Adhesives" (Members of the London Section of the Institute of the Plastics Industry are invited).

INSTITUTION OF ELECTRICAL ENGINEERS, LONDON STUDENTS' SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 7 p.m.—Mr. C. C. Barnes: "The Current Rating of Power Cables".

INSTITUTE OF WELDING, NORTH LONDON BRANCH (at the East Ham Technical College, Barking Road, London, E.16), at 7.30 p.m.—Dr. E. G. West: "Developments in the Welding of Aluminium Alloys".

Thursday, March 21

ROYAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Discussion on "Metrology" to be opened by Sir Charles Darwin, F.R.S. (The following will also take part—Mr. J. E. Sears: Standards of length; Mr. H. Barrell: Wave-length measurements; Mr. F. A. Gould: Standards of mass; Dr. L. Hartshorn: Electrical standards; Mr. J. A. Hall: The temperature scale.)

LONDON MATHEMATICAL SOCIETY (at the Royal Astronomical Society, Burlington House, Piccadilly, London, W.1), at 3 p.m.—Dr. John Womersley: "The Mathematics Division of the National Physical Laboratory".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Sir Henry Dale, O.M., G.B.E., F.R.S.: "Chemical Transmitters of the Effects of Nervous Impulses", 4: "Transmission of Excitation at Nerve Endings in Voluntary Muscle and Electric Organs; General Conclusions".

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. F. Ashworth, Mr. W. Needham and Dr. R. W. Sillars: "Silicon Carbide Non-Ohmic Resistors".

ROYAL PHOTOGRAPHIC SOCIETY, SCIENTIFIC AND TECHNICAL GROUP (at 16 Princes' Gate, London, S.W.7), at 6 p.m.—Discussion on "The Photographic Recording of Cathode Ray Screen Traces".

BRITISH ASSOCIATION OF CHEMISTS, NOTTS. AND DERBY SECTION (at the School of Art, Green Lane, Derby), at 7 p.m.—Prof. R. G. W. Norrish, F.R.S.: "Gaseous Explosions".

Friday, March 22

INSTITUTION OF MECHANICAL ENGINEERS (at Storey's Gate, St. James's Park, London, S.W.1), at 5 p.m.—Annual General Meeting. Mr. H. Desmond Carter: "The Loop Scavenge Diesel Engine".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Mr. C. F. Christopher Hawkes: "British Prehistoric Archæology—Recent Aims, Methods and Results".

INSTITUTION OF ELECTRICAL ENGINEERS, MEASUREMENTS SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Dr. A. L. Whiteley: "Theory of Servo Systems with Particular Reference to Stabilisation".

BIRKBECK COLLEGE (at Bream's Buildings, London, E.C.4), at 6 p.m.—Prof. C. T. Ingold: Inaugural Lecture on "Dispersal in Fungi".*

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in the Lecture Theatre of the Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—Prof. L. C. Burrill: "Marine Propeller Blade Vibrations; Full Scale Tests".

CHEMICAL SOCIETY (joint meeting with the LOCAL SECTIONS OF THE ROYAL INSTITUTE OF CHEMISTRY and the SOCIETY OF CHEMICAL INDUSTRY, at the North British Station Hotel, Edinburgh), at 7.30 p.m.—Dr. W. G. Ogg: "Trace Elements in Agriculture".

Monday, March 18—Friday, March 22

ROYAL SOCIETY OF MEDICINE (at 1 Wimpole Street, London, W.1), at 5 p.m.—"Practical Problems which faced Medical Science during the War". First week: "Problems of Protection".

(Monday: Cold and Heat; Tuesday: Burns, B.A.L., Missiles and Blast; Wednesday, Acceleration; Thursday: Applications of Anatomy and Physiology; Friday, Diseases in the Field.)

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER (woman) IN HORTICULTURAL SCIENCE, and a LECTURER (woman) IN HORTICULTURE—The Principal, Kent Horticultural Institute, Swanley, Kent (March 23).

LECTURER IN THE DEPARTMENT OF CIVIL AND MECHANICAL ENGINEERING—The Principal, Huddersfield Technical College, Huddersfield (March 23).

DIRECTOR OF THE MUSEUM AND ART GALLERY—The Town Clerk, Town Hall, Newport, Mon., endorsed 'Museum Director' (March 25).

ELECTRONICS ENGINEER (Graduate preferred) for Research Laboratory, near London, of leading British Oil Company—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 572, York House, Kingsway, London, W.C.2, quoting D.33.A (March 25).

EDUCATIONAL PSYCHOLOGIST (should possess an Honours Degree in Psychology)—The Chief Education Officer, County Education Offices, Northampton (March 25).

LECTURER IN PHYSICS AND MATHEMATICS, and a LECTURER IN ENGINEERING—The Principal, School of Technology, Tower Ramparts, Ipswich (March 29).

LECTURER IN MATHEMATICS (STATISTICS) in the Natal University College, Durban—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1 (March 30).

WAYNFLETE PROFESSORSHIP OF PURE MATHEMATICS—The Registrar, University Registry, Oxford (March 30).

LECTURER (Grade IIb or III) IN ORGANIC CHEMISTRY, and a LECTURER (Grade III) or ASSISTANT to assist with practical class for medical students and in research on the use of isotopes in chemistry—The Secretary of University Court, The University, Glasgow (March 30).

PSYCHOLOGIST to work under direction of County Psychiatrist (should hold Honours Degree in Psychology or comparable qualification)—The County Medical Officer, 4 Barnfield Crescent, Exeter (March 30).

RESEARCH ASSISTANT IN AGRICULTURAL CHEMISTRY—The Registrar, The University, Leeds (March 31).

SENIOR RESEARCH OFFICER at the Anti-Locust Research Centre in London—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 572, York House, Kingsway, London, W.C.2, quoting G.74.A (April 6).

DEMONSTRATOR IN THE DEPARTMENT OF CHEMISTRY, an ASSISTANT IN THE DEPARTMENT OF GEOGRAPHY, and a DEMONSTRATOR IN THE DEPARTMENT OF PHYSIOLOGY—The Secretary, Bedford College for Women, Regent's Park, London, N.W.1 (April 15).

LECTURER IN GEOLOGY—The Secretary, The University, Birmingham (April 30).

PHYSICIAN to take charge of Student Health Services—The Secretary, The University, Aberdeen (May 24).

CHAIR OF BACTERIOLOGY—The Registrar, The University, Sheffield (July 1).

LECTURER IN PHYSIOLOGY in the Department of Pharmacy and Biology—The Principal, Central Technical College, Birmingham 1.

SENIOR LABORATORY STEWARD IN THE PHYSICS DEPARTMENT—The Secretary, Northern Polytechnic, Holloway Road, London, N.7.

SENIOR LABORATORY STEWARD, and a LABORATORY STEWARD—The Head of the Department of Chemistry, Chelsea Polytechnic, Manresa Road, London, S.W.3.

RESEARCH CHEMIST by manufacturers of edible and non-edible gelatine and hide glue in South Africa—The Scientific Liaison Officer, South Africa House, Trafalgar Square, London, W.C.2.

LECTURE ASSISTANT IN THE CHEMISTRY DEPARTMENT—The Establishment Officer, University College, Gower Street, London, W.C.1.

CHIEF TECHNOLOGIST (knowledge of physiological experiments and general laboratory maintenance essential)—The Pharmacological Laboratories, Pharmaceutical Society, 17 Bloomsbury Square, London, W.C.1.